Thomas A Edison Papers

A SELECTIVE MICROFILM EDITION

PART II
(1879–1886)

Thomas E. Jeffrey
Microfilm Editor and Associate Director

Paul B. Israel
Assistant Editor

Mary Ann Hellrigel
David W. Hutchings
Douglas G. Tarr
Robert A. Rosenberg
Editorial Associates

Leonard DeGraaf
Joseph P. Sullivan
Alan Stein
Karen Kozak
John Deasey
Barbara B. Tomblin
Jacquelyn Miller
Maria Antonakakis
Student Assistants

Keith A. Nier
Assistant Editor

Reese V. Jenkins
Director and Editor

Sponsors
Rutgers, The State University of New Jersey
National Park Service, Edison National Historic Site
New Jersey Historical Commission
Smithsonian Institution

University Publications of America
Frederick, Maryland
1987

Thomas A. Edison Papers
at
Rutgers, The State University
endorsed by
National Historical Publications and Records Commission
18 June 1981

The original documents in this edition are from the archive at the Edison National Historic Site at West Orange, New Jersey.

FINANCIAL CONTRIBUTORS

PRIVATE FOUNDATIONS
Alfred P. Sloan Foundation
Charles Edison Fund
The Hyde and Watson Foundation
Geraldine R. Dodge Foundation

PUBLIC FOUNDATIONS
National Science Foundation
National Endowment for the Humanities

PRIVATE CORPORATIONS AND INDIVIDUALS

Alabama Power Company
Amerada Hess Corporation
AT&T
Atlantic Electric
Association of Edison Illuminating Companies
Battelle Memorial Institute Foundation
The Boston Edison Foundation
Cabot Corporation Foundation
Carolina Power and Light Company
Consolidated Edison Company of New York, Inc.
Consumers Power Company
Corning Glass Works Foundation
Duke Power Company
Exxon Corporation
Florida Power & Light Company
General Electric Foundation
Gould Inc. Foundation
Gulf States Utilities Company
Idaho Power Company
International Brotherhood of Electrical Workers
Iowa Power and Light Company
Mr. and Mrs. Stanley H. Katz
Matsushita Electric Industrial Co., Ltd.
McGraw-Edison Company
Middle South Services, Inc.
Minnesota Power
New Jersey Bell Telephone Company
New York State Electric & Gas Corporation
North American Philips Corporation
Philadelphia Electric Company
Philips International B.V.
Public Service Electric and Gas Company
RCA Corporation
Robert Bosch GmbH
San Diego Gas & Electric
Savannah Electric and Power Company
Schering Plough Foundation
Texas Utilities Company
Thomson-Brandt
Transamerica Delaval Inc.
Westinghouse Educational Foundation
Wisconsin Public Service Corporation

START

40

A Note on the Sources

The pages which have been filmed are the best copies available. Every technical effort possible has been made to ensure legibility.

THOMAS A. EDISON PAPERS

A SELECTIVE MICROFILM EDITION
PART II
(1879-1886)

REEL 40

NOTEBOOK SERIES (NBK-18)

Menlo Park Notebooks, #186 - #215

Menlo Park Notebook #186 [N-80-12-24.1]

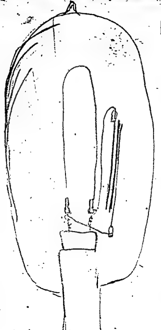
This notebook covers the period December 1880-February 1881. Most of the entries are by Francis Jehl. The notes, calculations, and drawings relate to special filament arrangements and to chemically treated and platinized carbons. There are also a few cross references by John Lawson to his experiments in Menlo Park Notebook #168. The label on the front cover is marked "Experimental Lamps (Special)," "1880," and "Francis Jehl." The book contains 284 numbered pages.

Blank pages not filmed: 274-277.

195
3)390
130

1

Lamp with Condenser



E 177
~~18840~~
3500

48 R
C

.177
3)354
118

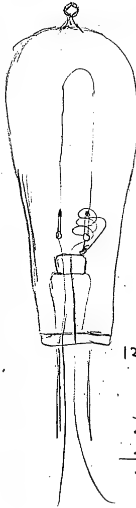
18840
3500
2)22340
111

188 : 130 :: 111 :

2.1139434
2.0453230
4.1592664
2.0718820
2.0873844

1.222
111
.11

2



E,182

18840
5000
2)23840
@ 48 119

.182
2
3)364
121

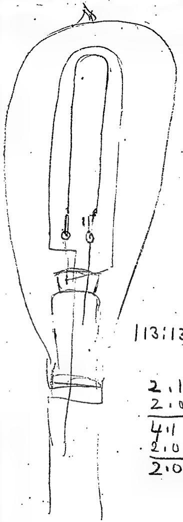
8 ohms

121 : 130 :: 119

127.8
119
8 ohms

2.113 94 34
2.075 54 70
4.189 49 04
2.082 78 54
2.106 70 50

3



E.170
2
3)340
113

18840
2200
2)21040
105
48 e

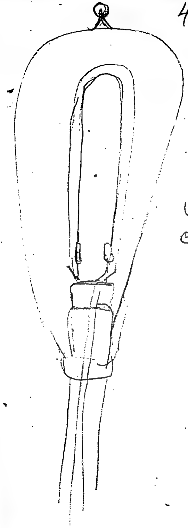
15 ohms

113 : 130 :: 105

120.8
105
15

2.1139434
2.0211893
4.1351327
2.0530784
2.0820543

4



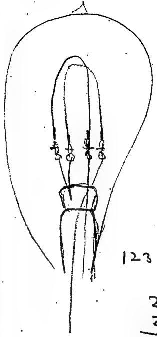
E 195
2
3390
130
R 18840
3000

48

Very blue at the clamp.

ok

5



E 184

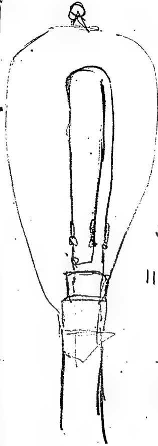
R 18840
4 (
2)23340
116
@ 48

184
2
3)368
123

123 : 130 :: 116

128.
116
12 ohms

2.1139434
2.0644580
4.1784014
2.0899057
2.1084963



E 175

R 1880
2700
221540
107

C 48

175
3)350
116

116 : 130 : 107

119
7
12

2.1139434
2.0293838
4.1433272
2.0644580
2.0788692

1/4/81 7

Treated with Petroleum
R 316.

E 182

25127
.3500
2(28627
143
48 e

182
3(364
121 v

10 ohms.

121 : 130 :: 143

2.1139434
2.1553360
4.2692794
2.0827854
2.1864940

153.
143
10

1/4/81 γ

Treated with P. [illegible]
R. 435

E, 202
31400 R
42000

202
2
3404
13

48°C

too high
OK..

treated with Petroleum
Q 380

E.182 = 121 10 ohms

R 25127
1500
226627
C 48133

121:130:133

2.1139434
2.1238576
4.2377950
2.0827854
2.1550096

143
133
10

Platinized 10 loop

E 205

R 31406 to high
2500
~~3~~33906

@ 48 ~~112~~ ~~thig~~

169 ohm 410
136 V

~~120~~

130 169.

11

Treated with Petroleum
R 335

E. 187

187
3)374
.124

25727
2700 R
2)27427
C 48 139 Johns

124 : 130 : 139

2.1139484
2.1430148
4.2569582
2.1093421 7
2.1635365

146
139
7

1/2 lamb. Treated 12 with Carbolic acid. R. 190 - 256

E. 98

6227	R
5800	

24 C.

13

Treated with Carbolic acid

*

R 190-256

E 101

R | 6277
| 8 200

24 C

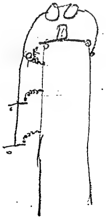
14 Carbolic Acid. 1

190 -- 256

E, 94

6279
5200 | R

C24



11 15 Carbolic Acid

(194

E, 97

.6279
~~6300~~ | R

@ .48

16

Phosphorus . marked
106 v no 3

C 180

3|360
120 v
104 R

18840
20000

C 48 2|20840
104 R

8 ohms

120 :: 130 :: 104

112
104
8

2.1139434
2.0170333
7.9208188
2.0517955

17

Phosphorus .

185
18840
6000

C 48

3|370
126 v
124 R

2|24840
124.

3 ohms

126 :: 130 :: 124

2.1139434
2.0934217
7.8996295
2.1059946

127
124
3

18

Chr. Carbon

Second test

128 121

12560
800
13360
48

128
121
2)249
124
3)248
83 v

37 ohms 66 ohms

~~83:130:66~~

103
66
37

~~2.1139434~~
1.8195439
8.0809219
2.0144092

19

Sodium

189 Blue at clamp

18840
4500
C48
~~2)63840~~
3

18840
4500
2)23340
116

189
2
3)378
126 v
116 R

3 ohms.

126:130:116

2.1139434
2.0644580
7.8996295
2.0780309

119
116
3

20

Napthaline.

149.5
18840
1000
2 19.840
99

48C

149
3 | 298
99.5
99R

31 ohms

2.1139434
1.9956352
8.0043648
2.1139434

130
99
31

21

Benzoin

141
12560
5600

C48 2 18160
90

94 : 130 : 90

141
3 | 282
94.5
90R
30 ohms

124
94
30

2.1139434
1.9542425
8.0268721
2.0950580 = 124

99 | 99 | 1
R | 99 | 1

22

Benzoin

133

12560
100
12660
C 48

3|266
89.7 U
63. R
28 ohms

89.7 : 130 : 63

91.3
63
28

2.1139434
1.7993405
8.0472076
1.9604915

3.9132839
1.9527924
1.9604915

23

Sodium

185

18840
7000
25840
C 48

185
2
3|370
123 U
129 R

7 ohms

123 : 130 :: 129

2.1139434
2.1105897
7.9100949
2.1346280

136
129
7

24

Napthaline

165

111.34 V
112 R
19 ohms

18840
3600

C48 22440

111 : 130 :: 112

2.1139434
2.0492180
7.9546760

2.1178374

131
112

19

25

Extremely high vacuum on pump.

175

~~3~~350

116 V
112. Res
13 ohms

18840
3600

C48 22440

116 : 130 :: 112

2.1139434
2.0492180
7.9355410

2.0987024

125.
112

13

26

Ex. high on pump

171 —

3|342
114 V
108 Res

15 ohms

18840
2800

C48 2|21640
108

114 : 130 :: 108 15 ohms.

2.1139434
2.0334238

4.1473672
2.1056904 9

2.0904523

123
108

15

27

R poor vacuum Condenser

195

~~Blunt~~

25127
2700

27827
C48

3|390

130 V
139 Res

OK

2.1139434

28

Bamboo 8/17 taper end

164 | 110.7 V
97. Res

18840
700
19540

17 ohms

48

110::130::97:

2.1139434
1.9867717
7.9586073
2.0593224
5.1007151
2.0413927
3.0593224

114
97
17

29

Bamboo 10/17 5 hours very gradually

386

E192

25127
2500
$\boxed{27627}$

129.6 V
138. R

C48

OK.

~~12~~

30

Bamboo 8/17 taper ends 267
P. 127

E 194

18840 130.9 v
2100 104 ohms
20940

ok

C 48

31

Bamboo 8/17 .035 thick
.261
.0625 outside ends

E 183.5 124.8 v
R 18840 129 ohms
7100
25940 5 ohms

48 C

125 : 130 : 129

2.1139434
2.1105897
7.9030890
2.1276221

134
129
5

32

~~Bamboo~~ .008 thick
taper from 19/1000 to 15/1000 no 2 & 9.

E 1.82.

R 18840.
5000.

2|23840 123 V
119 119 R

C 48. 6 ohms

123 : 130 :: 119

2.1139434 ~~158~~
2.0755470
7.9100949

2.0995853

125
19
6

33

Bamboo 10/17 very gradually .375

E 185

R 18840
7000
25840

124.85
129 ohms
5 ohms

C 48

125 : 130 :: 129

2.1139434
2.1105897
7.9030890

2.1276221

134
129
5

34

Paper. 9/17 781

Very bad Carbon
Ilec lamp. N.G

Bamboo .25 Circle .0625 mm
ends. 261.

180 E. 121.5 V
130 R

18840
7200

26040

4.8

Johns

122 : 130 : 130

2.1139434
2

4.2278868
2.0863998

2.1414870 138

36

Bamb 8/17 5 hours regular. 535

185

18840
8200
2)27040
135

48 c

3)370
123

3
8 ohms

123 : 135
123 : 130 :: 13.5

143
135
08

.2.1139434
2.1130333 8
7.910 0949
2.1543721

179
35
34

37

Bambo 8/17 taper on corner
and clipped off on end
.358

192
25127
.4300
29427

192
2)384
128

2 ohms

48 c

128 : 130 :: 147.

2.1139434
2.1673173
7.8927890
2.1740497

149.
147
2

38

Regular Clamped by deposits Dec 24 1880.

E 145.

1 2 5 6 0
700
2|13 2 6 0
66 ohms.

3|290
97
66 ohms
23 ohms

104
53

48 C

97 : 130 : 66

89
66
23

6279
4500
2|10779
53

2.1139434
1.8195439
8.0132283
1.9467156

3.9334973
1.9867717
1.9467156

53 ohms

Edison Exhibit No 7
June 10" 1885
C.W.F.
Notary Public

39

Regular Clamped by deposit

175

18840
2000
2|20840
104

C48

175
2
3|350
116

12 ohms

116 : 130 : 104

66
53
13

116
104
12

2.1139434
2.0170333
7.9355410
2.0665177

2.1139434
1.7242759
7.9829667
1.8211860

Edison Exhibit No 7.
June 10" 1885.
C.W.F.
Notary Public

40 Cu plated

Ex. High or point

Cot a bronze with ashes

No 15 1000

114.75 volts

18840
3500

2|22340
111. ohms

14 ohms

48 C

115 : 130 :: 111 : X + 111

2.1139434
2.0453230
7.9393022
2.0985686

125
111
14

41

No P bronze with ashes
9700 Cu plated

116.10 volts

18840
2000

2|20840
104 ohms

48 C

12 ohms.

2.1139434
2.0170333
7.9355470
2.0665177 = 116
104
12

No a treated with ashes
ag plated

114.75 volts

18840.
4~~2000~~

2)23640
118 ohms

15 ohms

48 C

133
118
15

2.1139432
2.0718820
7.9393022

2.1251274

No B treated with ashes
ag plated

122.85 volts

18840
5300

2)24140
120 ohms
48 C

6 ohms

2.1139432
2.0798812
7.9100949

2.1032193

126
120
6

✓

a treated with ashes.
Ag placed in C.

114.07 volts
18840
3000
2/21840
109 ohms

15 ohms

124
9
15

48 C

2.1139434
2.0374267
7.9430951
2.0944652

~~treated~~ with ashes
Ag placed in D.

114.75 volts
18840
3500
2/22340
111. ohms

14 ohms,

48 C

2 1139434
2 0453230
7.9393022
2.0985686

125
111
14

a treated with ashes
copper plated 99.5 volt
No 8.

112.72 volts

18840
1900
2/20740
103 ohms

15 ohms

48 C

2.1139434
2.1012872
7.9469216
2.0737022

118.
3
15

a treated with ashes
silver plated
No 9

116.10 volts

18840.
4500
2/23340
116 ohms

14 ohms

48 C

2.1139434
2.0644560
7935410
2.1139424

130.
116
14

Treated with ashes.
Silver plated

No 2

120.15 volts

18840
4600
2/23440
117 ohms
48 C

9 ohms

2.1139434
2.0681859
7.1920818
2.1029481

126
117
9

Treated with ashes

102.5 volts

No 3 Ag. plated

120.15 volts

18840.
4600
2/23440
117 ohms

9 ohms

48 C

2 1139434
2 0681859
7

a treated with ashes
101 volts Cu plated
no 4

117.45 volts

18840
4500 12 ohms
123340 116. ohms

48 C

2.1139434 128
2.0644580 16
7.9318141 12
2.1102155

a treated with ashes
96.5 volts Ag plated
no 1

111.34 volts
18840. 18 ohms.
2700
~~5840~~ 21540
48 C 107 ohms

2.1139434 125
2.0293838 07
7.9546760 18
2.0980032

104 treated with acid
no 17 Cu plated

123.52 volts
18840
4500

48 C

120.15 | 9 ohms
18840 | 125
4500 | 116
2/23340 | 9
116 ohms

2.1139434
2 0644580
7 9208188
1.10992202

102. treated with acid
no 20 copper plated

118.12 volts
18840
3000
2/21840
109 ohms
48 C

11 ohms

2.1139434
2 0374265
7 9281180
2.0794879

120.
109
11

✓

73 Carbon treated Carbotreated
R190 1/2 size
no 1

66.15 Volts
6279
6700
2|12979
64. ohms
24 C

Poo treated with acids
10 Cu plated

~~107.32 volts~~
~~18840.~~
~~3200~~

The carbon slipped out of the clamps

48 C

114.07 volts 15 ohms

18840 2.1139434
2600 2.0293838
7.19430950
2|21440 2.0874222
107 ohms
48

122
7
15

treated with ashes

101 V
No 14 Copper plated

~~103.95 Volts~~

~~18840.~~
3200

48 C
114.07 volts 14 ohms

18840 .. 2(21140
2300 105 ohms

48 C 2.1139434
2.0211893
119/14 7.9430950
2.0782227

0

13 Treated with acids
105 Ag plated

123.52

18840.
4900
2)23740
118. ohms

48 C 5.0 ohms

2.1139434
2.0718820
7.9065783
1.0924037

123
18
05

No E. Treated with acid
Cu plated

121.50 volts

18840. 7 ohms
4700
2/23540
117 ohms
48

2.1139434
2.0681859
7.9136402
2.0957695

124
17
7

No F Treated with acid
Copper plated shanks

114.75 volts

18840.
3300
2/22140
110 ohms
48 R. 14 ohms

2.1139434
2.0413927
7.9393022
2.0946383

124
10
14

 10415V Treated with acids

11. ag. plated

122.80 volts

188.40
5200.

24040
120 ohms

6 ohms

48 C

2 113 94.34
2 0791812
7 9100949

2.1032195

126

Treated with acids

No 6 ag plated
10415

119.47 V

11 ohms

188.40.
4700

24540
122 ohms

48 C

2. 113943.4
2. 086.3998
7. 9244520

2.1247952

133
22
11

Treated with acids.

No 4 Copper plated

116.77 volts

~~188~~.40
35 00

2)223 40
112 ohms

12 ohms

48 C

2.1 1139434
2.1 0492180
7.1 9318141

2109 5975 5

124
12
1.2

10* Treated with acid

107½ Ag plated

1#
120.115 volts —

18840
5700

2)24540
122. ohms

10 ohms

48 C.

2. 1139434
2. 0863598
7. 9208188

2112 11220

132
22
10

No T Treated with acid
10 US ag. plated,

118.12 volts

18840.
4300 11 ohms
2/23140
115 ohms

48 C

2. 113 9434
2. 0606978
7. 9281170

2.1027582 126
115
11

No 8 Treated with Carbolic acid
190 R ½ size

62.10 volts

6279
5000
2/11279
56 ohms

24 C

~~2. 1139434~~
2.
7.

2016 Treated with acid
1050 Cu plated

118.12 volts

18840 11 ohms
4700
423540 117 ohms
48 C

2 113 94 34
2 068 18 59
7 928 11 70
2.1 102463 12.8
1.7
11

106 Treated with acid
1220 Ag. plated

118.12 volts

18840 11 ohms
4700
223540
117 ohms
48 C

2 . 113 94 34
2 . 068 18 59
7 .

Treated with acids

10115
90
ag. plated.

116.10 volts

18840
3000
21840
109 ohms

13 ohms

48 C

122
109
13

2, 1139434
2, 0374265
7, 9355410
2, 0869109

lamp light 24
12. 2591

93.150 volts

12500
1400
13900
69 ohms

28 1-303. ✓

119.410

1.8840
3400

22240
48 C

111 ohms

1.0 ohms in coil

2.0755470
2 0755470
1 .6464037
7.9546760

3.75 2237

5652. ft

119:130 :: 111
130
3330

119) 111
1443 0 (121
119
253
238

100

order 12 268
21 ✓

117.45 volts

18840
5500
~~24340~~ 121 ohms
48 C

117.1130 :: 121

2.1139434
2 1082 7854
7 9318141
2.1 285429

13 ohms to be inserted

134
121
13

Campmanslaw

8

263

121.50 Volts

18840
5000

23840 = 119 ohm

48

7 to be wanted

2.1139434
2.0755470
7.9136402

2.1031306

126
119

7

8

order
28

275

or 28

119.47 Volts

18840
5800

24640 = 123 ohms

48 C

11 ohms

2.1139434
2.0899051
7.9244520

2.1283005

134
123

11

order 29 ✓ 12. 230

116.77 ✓

18840 11 ohms to be inserted
3100

21940 = 109 ohms

48 ℓ

$$\frac{120}{\frac{9}{11}}$$

2 113 94 34
2 034 42 65
7 93 18 140

2 10802839

order 29 ✓ $\frac{12}{246}$

116.10 ✓

18840
3800

2) 22640 113 - ohms

48 13 ohms wanted.

2.1139434
2.0530784
7 9355410

2.1025628

126
113

13

25 order ✓

$\frac{9}{264}$

114,07 ✓

18840
1600

2) 20440 (102 ohm
48

14 ohm insert

2,1139434
2,0086002
7943 0951

2,0656387

116
02
14

order 26 $\frac{7}{208}$ ✓

110,102 ✓

18840
800

2) 19640 (98.
48e

17 ohm insert

2,1139434
1,9912261
7,9586073

2,0637768

115
98
17

205 order
26

18840
1200

2 | 20040 | 100.

48

No 28. Chloride ammonia 5652 foot lbs –
21 = Painted with Cercle Carbon – 117.½ volts. 121 ohms
8 Piece Sodium, Res 119 – volts 121.50

lamp order 24 | $\frac{12}{259}$

118.12 v

10 ohms insert

18840
1300
20140 = 100 ohms

48

2.1139434
2.
7 9281170
2.0420604

25 order $\frac{10}{251}$

114.75 v

2)18840
94 ohms

48 C 12 ohms insert

2.1139431
1.9731279
7.9393022
2.0263732

106
94
12

58. 5/299

125.550

18840
7200

26040 = 130 ohms

48 e 4 ohms insert

2.1139434
2 1139434
7.8996295

2.12751.63 134

22 12/227

111.34 volts

18840
.1000

19840 = 99 ohms

48 e 17 ohms insert.

2.1139434
2.1995352
2.9546760

2.1064546

116
99

17

71 ✓

114.750 $\frac{11}{299}$

18840
3100
21940 = 109 ohms

48C 14 ohms inserted

2.1139434
2.0374265
7 9393022
2.0906721

123
109
14

74 $\frac{6}{283}$

122,170

18840
4500
23340 = 116 ohms

7 ohms insert

2 1139434
2 0644580
7 9136402
2.0920416

123
116
7

48C

53 $\frac{10}{250}$

115.430 ✓

$$\begin{array}{r} 18840 \\ 2800 \\ \hline 21640 \end{array} = 108 \text{ ohms}$$

48 ℮ 14 ohms insert

$$\begin{array}{r} 2.1139434 \\ 2.0334238 \\ 7.9393022 \\ \hline 2.0866694 \end{array}$$

$$\begin{array}{r} 122 \\ 108 \\ \hline 14 \end{array} \text{ ohms}$$

294 65

116.77 ✓

$$\begin{array}{r} 1.8840 \\ 800 \\ \hline 19640 \end{array} = 98 \text{ ohms}$$

48

10 ohms

$$\begin{array}{r} 2.1139434 \\ 2.9912261 \\ \cancel{8}.9318141 \\ \hline 2.0369836 \end{array}$$

$$\begin{array}{r} 108 \\ 48 \\ \hline 10 \end{array}$$

75 $\frac{1.0}{223}$

11812 volts

$$\begin{array}{r} 18840 \\ 2400 \\ \hline 21240 \end{array} = 106 \text{ ohms}$$

48 @ 10 ohms insert

$$\begin{array}{r} 2.1139434 \\ 2.0253054 \\ 7.9281170 \\ \hline 2.0673658 \end{array}$$

$$\begin{array}{r} 116 \\ 106 \\ \hline 10 \end{array}$$

50 order

$\frac{9}{249}$

1.20182 volts

$$\begin{array}{r} 18840 \\ 4500 \\ \hline 23340 \end{array} = 116 \text{ ohms}$$

48 @ 8 ohms insert

$$\begin{array}{r} 2\ 11\ 39434 \\ 2\ 0644580 \\ 7.9117.2146 \\ \hline 2.0956160 \end{array}$$

$$\begin{array}{r} 124 \\ 116 \\ \hline 08 \end{array}$$

·49 ~~275~~ 302

118.12 volts

18840.
3000

21840 = 109 ohms

48 @ 11 ohms inserts

2, 1139434
2· 0374265
7 · 9281170

21079 4869 120
09

11

67 10 250

121.50 volts

18840
4800

23640 = 118 ohms

48 @ 7 ohms inserted

2, 1139434
2, 0718820
7· 9136402

2,0994656
110
125
118

7

Ex 49 ✓ 10/2/15

118.8 volts

18840
4100
22940 114 ohms

48e 10 ohms insert

2.1139434
2.0569049
7.9244520

2.0953003 124
14
10

7/2/15 70

118.80 volts

18840
2700
21540 = 107 ohms

48e 10 ohms insert

2.1139434
2.0293838
7.9281170

2.0714442

117
10

73 $\frac{8}{257}$

119.47 Volts

18840.
6000
24840
124 Res

11 ohms insert

48 C

2.1139434
2.0934217
7.9244520
2.1318171

119 135
134
11

2.0755470
2.0755470
1.6464037
7.9065783
3.7040760

5059.
6
5384

21 ✓ $\frac{12}{223}$

113.40 ~~R~~ Volts

18840
1500
20340 = 101 Res.

15 ohms insert

48 C

2.1139434
2.1004321 4
7.946 9216
2.1065 1864

116

Order 55 $\frac{9}{272}$

115.430 volts

$$\begin{array}{r} 18840 \\ 3500 \\ \hline 22340 \end{array} = 111 \text{ ohms}$$

48C

14 ohms insert

$$\begin{array}{r} 2.1139434 \\ 2.1045320 \\ 7.9393022 \\ \hline 20.985686 \end{array}$$

$$\begin{array}{r} 125 \\ 111 \\ \hline 14 \end{array}$$

Order 25 $\frac{10}{288}$

108. volts

$$\begin{array}{r} 12560 \\ 5000 \\ \hline 17560 \end{array} = 87 \text{ ohms}$$

48C

17 ohms insert

$$\begin{array}{r} 2.1139434 \\ 11.9395193 \\ 7.9665762 \\ \hline 21.0200389 \end{array}$$

$$\begin{array}{r} 104 \\ 87 \\ \hline 17 \end{array}$$

order 26 $\frac{11}{205}$

111.34 volts

12560
7100
19660 = 98 ohms

48 C 16 ohms insert.

2, 1139434
1, 9912261
7, 9546760
2, 0598455

114
98
16

order 69 $\frac{10}{242}$

This one with a very faint current was red at the top ~~to~~ white the rest was black

116.100 volts

13 ohms insert

18840
3100
21940 = 109 ohms

48 C

2, 1139434
2, 0374265
7, 9355410
2, 0869109

122
109
13

Ex 63 $\frac{9}{291}$

124.83 volts

$$\begin{array}{r} 18840 \\ 7100 \\ \hline 25940 \end{array} = 129 \text{ ohms}$$

48 C 5 ohm inserts

Orlando Barum

$$\begin{array}{l} 2.1139434 \\ 2.1105897 \\ 7.9030890 \\ \hline 2.1276221 \end{array}$$

$$\begin{array}{r} 134 \\ 129 \\ \hline 5 \end{array}$$

Ex 51 8/263

118.80 volts

$$\begin{array}{r} 18840 \\ 4500 \\ \hline 23340 \end{array} = 116 \text{ ohms}$$

10 ohms inserted

48

$$\begin{array}{l} 2.1139434 \\ 2\ \ 0644580 \\ 7\ \ 9244520 \\ \hline 2.1028534 \end{array}$$

$$\begin{array}{r} 126 \\ 116 \\ \hline 10 \end{array}$$

 289 CCL$_3$

101.25 volts

12560
5900

18460 = 92. ohms

48 C 26 ohms insert

2.1139434
~~1~~.963787 8
7.9956786

2.0744098

$$\frac{118}{\underline{92}} \quad 26$$

or 60 $\overset{10}{\cancel{244}}$

118.12 VOLTS

18840
3100

21940 = 109 ohms

48 C 11 ohms insert

2 1139434
2.0374265
7.9281170

2.0794869

$$\frac{120}{\underline{}} \quad 11$$

 # 66 " 304

18840 113.40 volts
3700

22540 = 112 ohms

48 e 16 ohms insert

2 11394 34
2.04921 80
7 9469216

2.1100830

128
112

0
16

31 # 12
220

107.32 volts

18840
700

19540 = 97. ohms

48 e 20 ohms insert

2.1139434
1.9867717
7 9706162

2.0713313

117
97

20

*
Order 23

114.07 volts

18840
3000

21840 = 109 ohms

48C   15 ohms insert

2 113943 4
2 0374265
7 9430957

2.0944650   124
             9
             15

31   # 12
          248

122.85 V

18840   6 ohms inserted
5000

23840 = 119 ohms

2. 113.9434
2. 0755470
7. 9100949
48C
2.0995853

125
19
6

order # 12
27 239

114.75 volts

18840
3500
22340 = 111 ohms

48C 14 ohms inserted

2. 1139434
2. 0453230
7. 9393022

2. 0985686

125
111
14

ordered 27 # 12
232

113.40 volts

18840
1800
20640 = 103 ohms

48 15 ohms inserted

2. 1139434
2. 0128372
7 9469216

2. 0737022

118
103
15

52

This lamp went up in Show room.

No. 30 $\frac{14}{241}$

~~110~~ 118.80 V

$$\begin{array}{r} 18840 \\ 4000 \\ \hline 22840 \end{array} = 114 \text{ ohms.}$$

48 10 ohms wanted

$$\begin{array}{l} 2,1139434 \\ 2,1056 9049 \\ 7,9244520 \\ \hline 2,0953003 \end{array}$$

$$\begin{array}{r} 124 \\ 14 \\ \hline 10 \end{array}$$

$\frac{9}{255}$ $\frac{14}{239}$ or \ 103

111.34 volts

18840
2300

21140 105 ohm

48 @ 17 ohms inserted

2.1139434
2 0211893
7.9546760

2.0898087 $\frac{122}{17}$

16@ 3789 ft lbs
97.2 v
18840 8.7 HP
3300

22140 = 110 ohms

$\frac{14}{234}$ or 104

84.37 volts

37 ohms inserted

12560
1300

13860 = 69. Res

2.1139434
2 8388491
8.0357206

2.0285831 106
69
37

69) 3131

43530

14
1042
259

× 3.03 Volts

12560

~~10000~~

~~20560~~

37 ohms needed

13360 = 66 ohms

48 C

2.1139434
1.19543 9
8080.9219
.70144092

103
66
37

69.36 V

12560
1000
13560 = 61.8

16

V 69

ohms 67

10.6

69
69
621
414
4761
4744
19044
19044
67)209484 (3126
201
840
67
1704
444

3126 | 33.000

3126
11
3126
3126
3126
3126
~~330000~~
31260
174

12 or
268 72.

108.00 volts

18840
7400

26240 = 131 ohms

48 Candle 26 ohm inserted

2 113 94 34
2 11 7 27 13
7 96 6 57 6 2

2.1978809 157
131
26

or 289
68

120.15 volts

18840
3500

22340 = 111 ohms

48 C 12 ohms inserted

2.1139434
2.0453230
79208182

2.0800846 123
11
12 ohms

or 9
85 | 295

8 or
265 76

93,825

12560
2~~800~~
15360 = 76 ohms

Blue at Clamp

48 C 29 ohms used.

2,113 9434
7,880 8136
8,026 8721
20,216291

105
76
29

#12

or 30 244

124,2 v

18840
4000

22840 = 114 ohms

48 C

5 ohms inserted

2,1139434
2 0569049
7.9066783

2,0774266

119
17
05

or 77 9

245

127,57 v

18840
4700

23540 = 117 ohms

48 C

2 ohms inserted

2,1139434
2 0681859
7 8961960

2,1078325 6

119
17
2

86 11 278

143,15

Blue around the Camp

8 233 79

114075

18840
2300

21140 = 105 ohms
48C 14 ohms insert

2,1139434
2,021 1893
7,9430951

8,0782278 119
14

10 84

267

120.82 v

18840
5600
24440 = 122 ohms

48 e 9 ohms insert

2.1139434
2.1086358
7.9172145
2.1175177

137
22
09

12# order
22
245

116.7 v

18840
2800
21640 = 109 ohms

48 e 11 ohms insert

2.1139434
2.0374265
7.9281170
2.0794869

120
9
11

or 80 270

117.45 v

18840
21 00

20940 = 103 ohms

48

11 ohms insert

2.1139434
2.0128372
7.9318141

2.0585947

164
153
11

or 85 9
295

127.57 v

18840
7400

26240 = 131 ohms

48

3 ohms insert

127 ; 130 ; 131

2.1139434
2.1172713
7.8961963

2.1274110

134
131
3

p137 Platinized Loops

141.75 V
25127
7000

48 C

at 130 V = 25 C

25127
200

2 (25927
129.

25327
126

18840
5800

24540 = 122

January

order no 6 5 mg napthaline crystals dissolved in gasoline smashed around!

((8) (no 2.)) (18 334) (109v / 28)

1.30 volts

1840 / 9000 } Res

200

48 C ok

Platinized loops 1/5/81

p 137 loop Soaked in Pt Cl

96½

112.72 volts

1840 / 1600 R

20440 = 102 Res

48

113 : 130 :: 102 15 ohms

2.1139434
2.0086002
7.9469216

2.0694652

117
102

15

(hrs 2,38 healed quick) (11 / 261)

100 1/2 V 4

118.8 volts

18840
5600
24440 = 122 ohms
48 Candles

11 ohms

119 : 130 :: 122

2.1139434
2.0863598
7.1244520
2.1247552

133
122
11

('25/81) ('1.6/20 106)

128.25 volts

18840
6000
24840 = 124 ohms

48 C

2 ohms

128 : 130 :: 124

2.1139434
2.0934217
7.8927890
2.1011541

126
24

$\frac{6}{209}$ 1/25/81

(no 16)

124.83 volts

1840 } Res
3100

21940 = 104 ohm

4 ohms

2.1139434
2.0170333
7.9030890

2.0340657

108

order no 13

22 high

64.13 v

40 ohms

6279 } Res.
1600

7879 = 39.

64.130.39

79
39
40

2.1139434
1.5910646
8.1938190

1.8988270

* Large face tube on pump, Heated quick 2 hours

37 Candles at 130 volts

N. G.

Large face tube on pump heated quick 2 hours.

$\frac{13}{232}$

116.10 volts

$$\begin{array}{r} 18840 \\ 3200 \\ \hline 22040 \end{array}$$ R. = 110 ohms

116 : 130 :: 110   13 ohms

$$\begin{array}{r} 2.113 9 4 3 4 \\ 2\ 041.3.9 2 7 \\ \hline 7.9 3 5 5 4 1 0 \\ \hline 2.09087.71 \end{array}$$

$$\begin{array}{r} 123 \\ 10 \\ \hline 13 \end{array}$$

Heated quark 15
2 hrs 263

119.47 volts

10 ohms

18840 | R
3200 |
22040 110 ohms
48 C

119 :: 130 :: 110

2.1139434
2.0413927
7.9244520
2.0797881

√

120
10

order no 15 18.
970 283

118.12 volts

18840 | R
2400 |
21240 = 106 ohms
48 C 10 ohms

118 :: 130 :: 106

2.1139434
2.0253059
7.9281170
2.0673663

11.6
0.6
10

order no 14 no 4

NH_3 in C. 102 v

12 17

120,15 volts

18840

4400 | R

23240 = 116 ohms

48 C 9 ohms

120 : 130 :: 116

2.1139434
2.0644580
7.9208188

2.0992202

125
10
9

Quick heated 15

2 hrs 40 250

122,85 volts

4900 R
18840

23740 = 118 ohm

48 C 6 ohms

123 : 130 :: 118

2.1139434
2.0718820
7.9100949

2.0959203

124
118
6

Heating quick
101 v 2.56
(14)

122.85 volts

5500
18840
24340 = 121 ohms

48 C 6 ohms

123 : 130 :: 121

2.113 9434
2.082 7854
7.910 0949

2.106 8237

127
21
6

Heating quick 2.56

15
294
103½ 19

~~122.85 volts~~

18840
7600
26440 = 132 ohms

48 C 7 ohms

123 : 130 :: 132

2.113 9434
2.120 5739
7.910 0949

2.144 6122

139
32
7

heated quick $\frac{16}{243}$
2.38 hrs.
102½ v
6.

120.82 volts

8 ohms

18840 } Res
3000
~~[illegible]~~
22840 = 113. ohms

121 : 130 :: 113

48 C

121 : 130 :: 113

~~130 : 121 :: 113~~

~~2. 1139434~~
~~2. 0530784~~

3.7
quick heat $\frac{16}{243}$ 116 v 30

130.2 voltmeter at 35 C

2.1139434
2.0530784
7.9172146

2.0842364

~~2. 1139434~~
~~2. 0530784~~
~~7. 9172146~~

~~2. 0842364~~

~~121~~

121
13
8

Heated Quick

3.34 5
355

$101\frac{1}{2}$ 17

124.83 volts

$\left.\begin{array}{r}18840 \\ 4800\end{array}\right\}$ Re. 118 ohm

23640 = 118 ohms

48 ohms 4 ohms

125 : 130 : 118

2.1139434 122
2.0718820 118
7.9030890 4

2.0889144

heated quick

3.34 5
$99\frac{1}{2}$ 13 349

~~122.17 volts~~

121.50 volts 7 ohms

18840
4500 Res, = ~~119.17~~

23340 = 116 oh

122 : 130 : 116

2.1139434 123
2.0644580 116
7.9136402 7

2.0920416

heated quick 99
hrs 3.34 $\frac{11}{365}$ 1

$103\frac{1}{2}$ 13 $\frac{13}{257}$

quick heated 2.40
124.920
123 R
2 ohms inst.

quick Lealie 3.19

13 263 .105

128.920

127 R.

2 ohms insert

quick Lealie

319.16 235 980

6

122.170

107 Res

7 ohms insert

quick healing 16
319   259

1105 21

128.25 v.
118 ohms R
2 ohms invert

quick healing
16 257   100½ 2

122.17 volts
119 R
8 ohms invert

liquid quick

$98\frac{1}{2}$ hrs 3.34 11

19 310

121,500

113 R

8 ohms insert.

quick liquid

2.43. 13/241 119 8

33 Candles at 1300

W.G.

heated quick
98 3 2.38

120.15 v
113 R
10 ohms used

heated quick
2.56 * 16 261

122.85 v
118 ohms R
7 ohms used

Loaded quick

$\frac{15}{226}$ 238 $\frac{101}{2}$

121.50 v
110 R
7. ohms insert

quick loaded

3.7. 96 v 24

121.5 v
104 R
7 ohms insert

quick heated
2.38 $\frac{15}{224}$ 99 V, 1.

121.5 v
112 R
8 ohms curent

// heated quick
365 hrs 3.34

120.82 volts
117 ohms R.
9 ~~11~~ ohms curent

99
—
1

heated quick

13
223 2.56
102½ 7

122.85 v
10.7. R.
6 ohms insert.

heated quick

2.38 94½ 10
15
225

118.80 v
109 R.

1.0 ohms insert.

 January 29 1888

Lot of 21 a order 46

285 1020
18

129.60
66000
18840 | R

OK

48 C

Caustic of Potash

Order 46 R 308.

107 1/2 26

130.27

8600
18840 | R

OK

48 C

order 46 R 283

Pump with Caustic Potash
" " 27 order 46
283
105 V.

129.160 V

7600 | R
18840
26440 = 1
R 48 C

OK

Order 46 R 283
105 V
14

128.125 ✓
18840 | R
8200
27040 135 ohms
2 ohms

2,113934
2,1130338
7.892789
2.1370762

137

Order 46 R 334

108 ½ V 3

131.63 V

9900
18840 | R

48 C

Order 46 R 289

108 V

9

131.63 V

~~8~~ 8400
18840 | R

OK

order 45 R 3

110 √

6

134.32 √

25127
3900 | R

order 46 104 √

R 325

129.160 √

25127
3900 | R

ok.

28027 = 140 R

Order 4 6 10.8 V
R 299 10

131.63 V

1700
25127 | R
26827 = 1.34 ohms

2.1139434
2.1127104.8

97 V 19
20 RK 11615

on deposits

120.15 V

9 ohms insert

4400
18840 | R
23240 = 116 ohms

2.113 94 34
2.064 45 80
7.920 81 88
2.099 22.02

125
10
9

 101 V 20 1/27/81, 20#
Cu deposit,

120.15 V

$$\frac{\begin{array}{r}3700\\18840\end{array}}{22540} \Big| R \quad -112 \text{ ohms}$$

48 C   9 ohms inset

$$\begin{array}{r}2.113\,94\,34\\2.004\,92\,1\,80\\7.920\,81\,88\\\hline 2.0839.802\end{array}$$

$$\frac{\begin{array}{r}121\\12\end{array}}{09}$$

106 V
2.7   20
Cu depositor

126.22 V

$$\frac{\begin{array}{r}5900\\18840\end{array}}{24740} \Big| R = 123 \text{ ohms}$$

48 C   4 ohms.

101 1/2 v
15 an deposit

119.47 v

1700
8840 | R

20540 = 102 ohm

2.1139434
2.0086002
71924520
2.1046995 6   9 ohms insert

94 1/2 v
21

109.38 volts

12560
6100 | R

18660 = 93 ohms

17 ohms insert

Order ~~158~~ $98\frac{1}{2}$

~~No 16~~(B)

No 16(a)

$108\frac{1}{2}$ v

130 Volts

130 Ohms.

0 Coil

48 Inches.

E δ 158.

185 def. = 124.83 v

18840
4100
22940

* 5 ohms unit

114 ohms

48

125 : 130 : 114

2.1139434
2.1056904.9
79030890
2.1073 9373

118
4
5

1350
116.6

C. 158

175 def. = 118.12 v

18840
4600
2(23440
117 ohms

* 12 ohms unit

118 : 130 : 117

2.1139434
2.1068.1859
7.928117 0
2.1102463

129
117
12

a

or 185.

127.57 volts

189 def

18840
4600

2 | 23440

117 ohm

* 2 ohms

128 : 130 : 117

2.1139434
2.0681859
7.8927890

2.0749183

118

16(b). 98½ or 158.

175 def

118.125

18840
800

2 | 19640

98 ohms

* 10 ohms

118 : 130 : 98

2.1139434
1.9912261
7.9281170

2.0332865

108
98
10

158.

D.

180 Def. 121.5 V

18840
3700 | Def. Res

2 | 24540

122 ohms * 9 ohms

2.1139434. 130
2.0863598
7.9136402

2.1139434

179 Def = 120.82 V

18840
2900

2 | 21740

108. R * 8 ohms insert

121 : 130 :: 108

2.1139434
2.0834238
7.9172146

2.0645818

116
08

8

Order 132 R 220
Feb 2 1881
8

118.12 V

18840 | R
400
19240. = 96 ohms

48 C   9 ohms mact

118 : 130 :: 96

2.1139434
1.9822712
7.9281170
2.0243316

105
96
9

Feb. 2, 1881.
Order 132 R210
15

18840 | R
1400
20240   101 ohms
48 C

15 ohms mact

112.72 V

2.1139434
2.0043214
7.9469216
21065864

116
101

Feb. 2, 1881.
Order 132 R220
20

117.450

18840 | R
3400

22240 111 ohms.
48 12 ohms meant.

2.1139434
2.0483230
7.9318141

2.0910805

123
11
12

Feb. 2, 1881.
Order 132 R245
24 (B)

~~12.4.45~~ 5
112105 5 16 ohms meant

18840 | R
1600

2.0440 = 102 ohms
48

2.1139434
2.0086002
7.9507810

2.0743246

118
102
16

Feb. 2, 1881.
Order 132, R 270
12

121.50 V

18840
3600 | R
22440 = 112 ohms

7 ohms inser[t]

48 C

119
12
7

2.1139434
2.0492180
7.9136402

2.0778016

Feb. 2, 1881.
Order 132, R 248
25

118.12 V

18840
2700 | R
21540 = 107 ohms

48 C

11 ohms insert

2.1189434
2.0293838
7.9281170

118
107
11

2.0714442

Feb. 2, 1881.

Order 132, R 255

17

121.50 V 7 ohms insert

18840
2800 | R

21640 = 108 ohms

48 C

115
8
7

2.1139434
2.0334226
7.9136402

2.0610074

Feb. 2, 1881.

Order 132, R 230

19

116.77 V

18840
2500 | R

21340 = 106 ohms

48 C 12 ohms insert

2 1139434
2.0253059
7.9318141

118
106
12

2.0710634

Feb. 2, 1881.
Order 132 H.ee

120.15 V

18840
4200 | R

23040 = 115 ohms

48 C

9 ohms insert

2.1139434
2.0606978
7.9208188

2.0954600

124
15

9

Feb. 2, 1881.
Order 132, R208.
102 - 20

113.40 V

18840
1100 | R

19940 | = 99 ohms

48 C

15 ohms insert

2.1139434
1.9956352
7.9469215

2.0565001

164
99

65

Feb. 2, 1881.
Order 132, (No tag)
105 1/2 V 2.4 (A)

~~120.15 v~~

~~115~~

1. 116.77 v

18840 | R
2100
20940 = 104 ohms

11 ohms insert

C 48

2. 1.13 9 4 5 4
2.017 0 3 3 3
7.931 8 1 4 1
2.062 7 9 0 8

11.5
04
11

Feb. 2, 1881.
Order 132, R 270
100 1/2 — 4

114.75 v

18840 | R
4800
23640 = 118 ohms

48 C

15 ohms insert

2. 1.13 9 4 3 4
2.07.1 8 8 2 0
7.939.30 2 2
21.125 7 2 7 6

133
118
15

Feb. 2, 1881.
Order 132, R20
16

~~112.72~~

112.72 v

15 ohms inst

$$\begin{array}{r|l} 18840 & R \\ 1500 & \\ \hline 20340 & = 101 \text{ ohms} \end{array}$$

48 C

$$\begin{array}{r} 2.1139434 \\ 2.0043214 \\ 7.9469216 \\ \hline 2.0651864 \end{array}$$

11.6

Feb. 2, 1881.
Order 158 — U

121.50 v

$$\begin{array}{r|l} 18840 & R \\ 6800 & \\ \hline 25640 & = 128 \text{ ohms} \end{array}$$

8 ohms insert

48 C

$$\begin{array}{r} 2.1139434 \\ 2.1072100 \\ 7.9136402 \\ \hline 2.1347936 \end{array}$$

$\frac{136}{8}$

Feb. 2, 1881.
Order 138-R 300
26

121.50 V

18840
6800
25640 = 128 ohm

48 C 8 ohms insert

Feb. 2, 1881.
Order 158-R 158
9

118.12 V

18840
4000
22840 = 114 ohm

48 C 11 ohms insert

2.113.9434
2.056 904.9
7.928 1170
2.098?653

125
14
11

Feb. 2, 1881.
Order 158 - W

116.10 V

18840
4000

22840 = 114 ohms

48 C 13 ohms insert

2.113 94 34
2.056 70 49
7 925 54 10

2.106 38 93

127
114
13

Feb. 2, 1881.
Order - 158 C *

121.50 V

18840
7000 | R

25840 = 129 ohms

48 C 8 ohms insert

2.1113 94 34
2.1110 58 97
7.913 64 02

2.1381733

137
129
8

Feb. 2, 1881.
Order 158 Y

121.50

18840
7300 | R

26140 = 130 ohms

8 ohms in

48 C

122 . 130 : : 130 . 138

2 113 9434
2 113 9434
7 9136402

2 1415270

Feb. 2, 1881.
Order Z 158
Twice ~~exp~~ exchanged

124.83

18840
6600 | R

25440 = 127 ohms

48 C 5 ohms in circ.

125 : 130 : : 127
127
910
260
130
125 / 16510 / 1

2 1139434
2 1038037
7 9030890
2 1120836 1

132
127
5

Feb. 2, 1881.

X

Order 158

121,50 V

18840	R
2700	
21540	= 107 ohms O.

7 ohms in ckt

122 : 130 : 107 : ~~1~~X

130
107
910
130

122 / 13910 / 114
122
171
122
490
488
.2

114
107
7

Feb. 2, 1881.

Marked H. J. N.

101.25 V

12560	R
1100	
13660	= 68 ohms

48 C

101

Feb. 2, 1881.
Tag — 1/27/81 — #21
Bk 1. p. 15 (20)
J. W. L.

~~E. M.F. 130 V — ok.~~

126.9 V

2 ohms R

18840
6100
24940 | 1.24 ohms obis

127 124
130
372
124
127/16120/126
127
342
254
880
762
118

126
124
2

Feb. 2, 1881.
Order 117 — 101½ V.
1

124.83 V

18840
4600
23440 = 117 ohms

4 ohms insert

48 e

1130
351
117
125/15210/121
125
271
250
210
125
85

121
117
4

Feb. 2nd 1881.

Order 117-101 V.

~~two half 2 coops in the~~

~~coop~~ 119.47 V

18840 11 ohms inert
5700

24540 = 122 ohms

48 C

122
130
3660
122

119)15860(133
119
396
357
390
357
33

Feb. 2, 1881.

Old #9 - 99½ V
12

one with a Condenser

120.82 V

18840 | R 8 ohms inert
3500

22340 = 111 ohms

48 C

111
130
3330
111

121)14430(119
121
233
121
1120
1089
31

11
8

2 8

5762) 33000 (6 +
34572

519

127
127

869
254
127

16129
4403

48387
64516
64516 2

124) 7145147 (5762
620

945

2

945
868

771 2
620

51

771
744

27 0

Feb. 3, 1881
Order 44 - R 275
104 1/2 V - 5

130,27 V

~~[illegible]~~ 1884 0
5200 0

24040 = 120 R,

OK

4 C

Feb. 3, 1881.
Order 44 - R 275
112 V - 4

~~to~~ 130,27 V

25127
5200

30327 = 151 ohms

24 e at this.

Feb. 3, 1881.
Order 44 - R 230
95 V - 1

116.77 V

18840
300

19140 = 95 ohms
10 ohms

48 C

~~20~~ ohms wint.

105
95
10

2.1139434
1.9777236
7.9318141

2.0234811

Feb. 3, 1881.

Order 44 - R 245
95 V - 22

114.75 V

18840
600 | R

19440 = 97 ohms

48 C   12 ohms used

1139434
9867717
9393022

0400173

109
97
12

Feb. 3, 1881.
Order 44 - R 285
107½ V - 10

130. V

25127
1500

26627 = 133 ohms

36 C

Feb. 3, 1881.
Order 44 - R 2.50
97 V - 17

118.12 V

18840 R
2000

20840 = 104 ohms

48 C

100 ohms used

113943.4
0170333
9281170

.0590937

114
4
10

Feb. 3, 1881.
Order 44 — R 300
113 1/2 V — 3A

1 30 : V

$$\frac{\begin{array}{r}25127\\3000\end{array}}{28127}\ R \quad 140\ R$$

38 C

Feb. 3, 1881.
Order 44 — R 280
106 V — 27

130 V

$$\frac{\begin{array}{r}18840\\5200\end{array}}{24040}\ R = 120\ \text{ohms}$$

48 C

OK

Feb. 3, 1881.
Order 44-R 280
111½ V-6

130. V

$$\begin{array}{r} 25127 \\ 1300 \\ \hline 26427 \end{array} \text{ R} = 132 \text{ R}$$

36 C

Feb. 3, 1881.
Order 44-R 295
112 V-13 B

130 V

$$\begin{array}{r} 25127 \\ 3200 \\ \hline 28327 \end{array} \text{ R} = 141 \text{ ohms}$$

36 C

Feb. 3, 1881.
Order 44-R 270.
108 V-25

130 V

25127 R 125 ohms

48 C

OK

Feb. 3, 1881.
Order 44-R 285
109 V-13

130 V

$$\begin{array}{r} 18840 \\ 6800 \\ \hline 25640 \end{array} \; R = 128 \; R.$$

48 C

OK

Feb. 3, 1881.
Order 44 – R 290
99 V – 11

124.83 V

$$\frac{\begin{array}{r}18840\\3500\end{array}}{22340} = \ 111 \text{ ohms}$$

48

OK

Feb. 3, 1881.
Order 44 – R 300
104½ V – 25

130. V

$$\frac{\begin{array}{r}18840\\7100\end{array}}{25940} = \ 129$$

48

OK

Feb. 3, 1881.
Order 44 – R 310
113 V – 23

130 V

18840
9700 R

28540 = 1.42 ohms

48 C

OK

Feb. 3, 1881.
Order 105 – R 337
108 V – 15

130 V

18840
7300 R

26140 = 1.30 ohms

48 C

OK

Feb. 3, 1881.
Order 105 - R 278
111½ V - 13

130 V

18840
8300 R

27140 = 135 ohms

34 C

Feb. 3, 1881.
Order 120 - R 312
113½ V - 24

130 V

25127
4000

29127 = 140 ohms

32 Candles

Feb. 3, 1881.
Order 120 - R 480
Lot 8 - High 22

130 V
very high R.

Feb. 3, 1881
Order 131 - R 405
115 V - 17

130 V

$$\begin{array}{r} 25127 \\ 6500\,R \\ \hline 31627 \end{array} = 158 \text{ ohms}$$

33 C

Feb. 3, 1881.
Order 131 – R 375
118 V – 15

130 V

25127
8200 R

33327 = 166 ohms

30 C

Feb. 3, 1881.

Order 137 – R 345
18

130 V

25127
5700 R

30827 = 154 ohms

34 C

Feb. 3, 1881.
Order 137 – R340
30

found it busted.

Feb. 3, 1881.
Order 137 – R310
7

130 V

18840
3500 R

22340 = 111 ohms

30 C

Feb. 3, 1881.
Order 143-R 410
122 V-7

130 V

25127
7500 R

32627 = 163 ohms

22 C

Feb. 3, 1881.
Order 143-R 420
1

130 V

25127
6000 R

31927 = 159 ohms

48 C

OK

Feb. 3, 1881.
Order 143 (A)

130 V

25127
7300 R

32427 = 162 ohms

26 C

Feb. 3, 1881.
Order 143 (B)

~~130 V~~
~~25127~~

to high Res

Feb. 3, 1881.
Order 131 — R 185
123 V — 23

busted when got it,

Feb. 3, 1881

Order 131 — R 380
116½ V — 1

130 V
25127 V
9500 R

34627 = 173 ohms

48 C

Feb. 3, 1881.
Order 125 - R 360
118 V - 16

130 V

25127
6500 R

31627 = 158 ohms

81 C

Feb. 3, 1881.
Order 125 - R 355
119 V - 30

130 V

25127
6200 R

21327 = 106 ohms
22 C

Feb. 3, 1881.
Order 125 - R 330
117 1/2 V - 7

130 V

25127
3300 R
28427 = 142 ohms

29 C

Feb. 3, 1881.
Order 127 - R 410
121 1/2 V - 6

130 V

25127
8300 R
33427 = 167 ohm

C 23

Feb. 3, 1881.
Order 126 - R 290
118 1/2 V - 3

130 V
25127
4300 R
29427 = 147 ohms

24 e

Feb. 3, 1881.
Order 126 - R 290
103 1/2 V - 22

~~130 V~~

~~25127~~
~~4300~~

121.50 V

Feb. 3, 1881.
Order 126 – R 256
99½ V–2

119.47 V

25127
1000 R   12 ohms in ext

26127 = 130 ohms

48 C

113943 4
11 394 3 4
92 445 2 0

143
330
12

1523388

Feb. 3, 1881.
Order 138 – R 290
13

120.825

18840
3500 R   8 ohms in ext

22340 = 111 ohms

48

119
11
8

113943 4
045 32 3 0
917 214 6

20764810

Feb. 3, 1881.
Order 138 - R 315
.23

130 V

18840
5900
24740 = 123 ohms

48 C

ok

Feb. 3, 1881.
Order 129 - High 16

found it busted

Feb. 3, 1881.
Order 129 - High 19

No vacuum. Went up

Order 107 - R 429
121 V - 4

130 V

25127
9800
34927 = 174 ohms

16 Candles.

Feb. 3, 1881.
Order 115 - R 365
120 V - 17

130 V

25127
9800 R

34927 = 174 ohms

19 C

Feb. 3, 1881.
Order 115 - R 340
116 V - 3

130 V

25127
7600 R

32727 = 163 ohms

25 C

Feb. 3, 1881.

Order 115 — R 334

112 1/2 V — 9

130 V

$$\begin{array}{r} 25127\ R \\ 7300\ R \\ \hline 32427 = 162 \text{ ohms} \end{array}$$

26 C

Feb. 3, 1881.

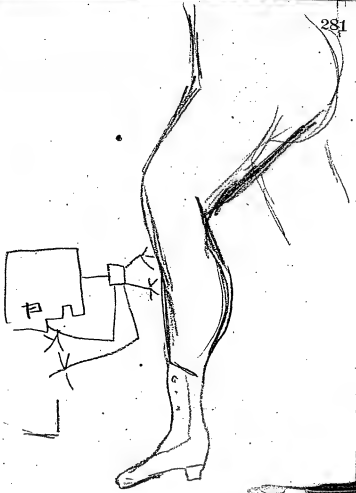
Order 115 — R 350

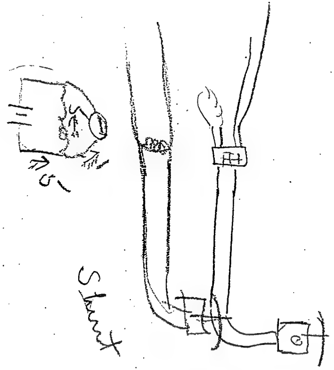
122 1/2 V — 16

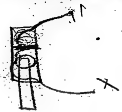
130 V

$$\begin{array}{r} 31406\ R \\ 5000\ R \\ \hline 36406 = 182 \text{ ohms} \end{array}$$

16.5 C




Start



$$\mathcal{E} - e = \frac{\mathcal{E}}{R}$$

$$CR = \mathcal{E}R$$

$$R = \frac{\mathcal{E}}{C}$$

1 ω

3 e

$\mathcal{E}$

120

115
11.5
575
115
1725

6368

200)1000(.00

200)1000(.005

$\frac{11}{10}$ ℧ 6 1V

$\frac{1}{10000}$ R 500 ohm

.104 .. .130 53

2.1139484
1.7242759
7.9829667
1.8210840

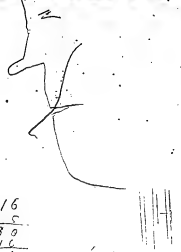
Menlo Park Notebook #187 [N-81-01-00]

This is one of six notebooks that were probably begun on January 10, 1881. It contains notes by Charles Batchelor on gas lighting, which appear to be related to Edison's proposed book on electric light and power. (See Menlo Park Notebook #184). There are additional entries by Batchelor, along with entries by Edison and occasionally by other members of the laboratory staff. Included are notes, calculations, and drawings relating to meters; and drawings of dynamos, voltage regulators, and other electrical devices. The book contains 284 numbered pages.

Blank pages not filmed: 78-81, 116-119, 140-143, 146-241, 252-259, 262-271.

Missing page numbers: 281-282.

1.265



16
5
80
16
16
4
64
16
8.0

65
4
260

1000
260
4) 740 | 185
4
34
32
20

Cost of Laying Gas Mains
P364 No 32
Treat. on Coal Gas

Yearly table of Gas burning hours
Gas Engineer [illegible]

8
4
2
1/3 way through

Get first case where gas was sold to consumers?

Get Stat[illegible] of gas as a manufacturing industry

~~What was~~ Money [illegible] in Railroads

English £170.000
French. ₣101.877
United States £60'000

(8)

72 623
60000
4357380000
676-686-586
5413392688
10909
1018770
30852
101900
3143818800
4010
60000
240600000
1018773500
305631
30852000
102000
3146904000

U.S. 72.623 miles at $60 000 — 4 357 380 000
Gt. B. & I. 16082 at £170,000 — 3 248 085 000
~~£ 676, 686, 586~~
305 631 000
France 10.847 at 101.877 — 1 110 459 000
Rusia 10 725 at — 305 631 000
1 109 000 000
Rest of Europe 30852 at — 3 143 819 000
Canada 4010 60000 — 240 600 000
13.820.605,000
South A - Mexico etc — 3.146 900.000
Asia — 16.967 505 000
Australia

12
2
24 24

Relating to Gas
under heading
of Gas
Gas plant
Coal gas

Annual production of Coal 1874
260,000,000, tons
Enc. Brit Vol VI page 73

---

up to date in Great Britain
there is consumed for illuminating
purposes Tons 1010-000-000
Newbiggins Page 25

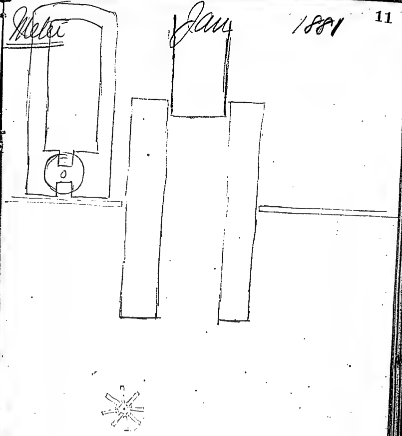
Paris 1878.

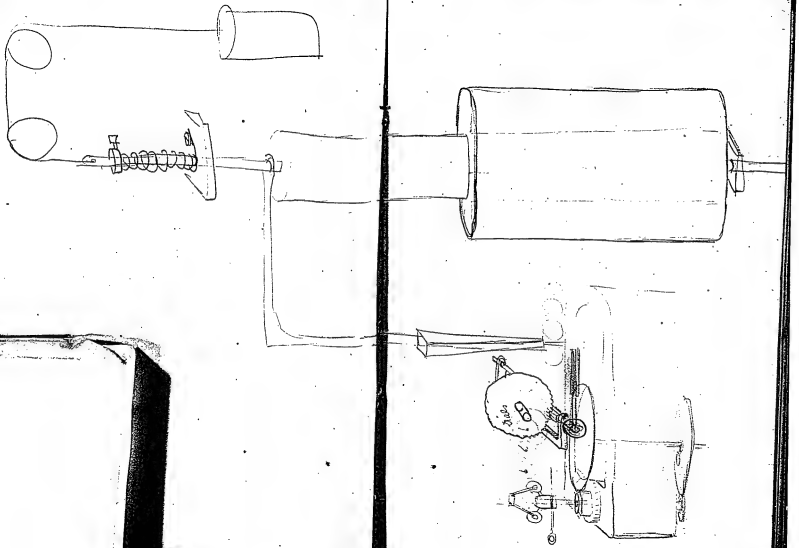
7,484,000,000. Cub. ft gas

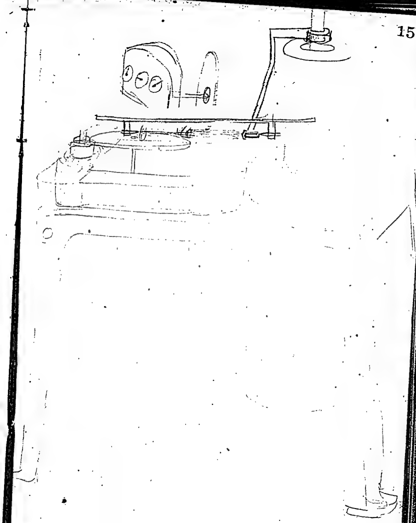
Public lamps 45,000,

Gas engines in Paris consume
35,300000 C.F. per year

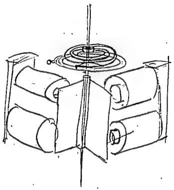
Meter Jan 1881

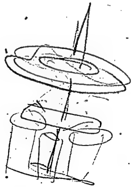


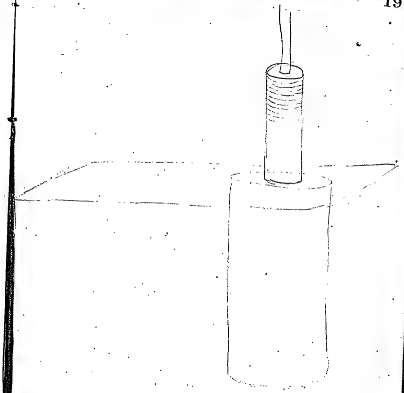




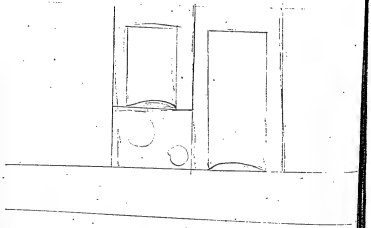
len

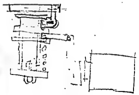


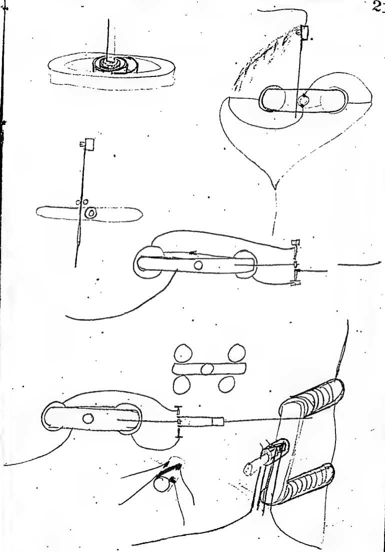




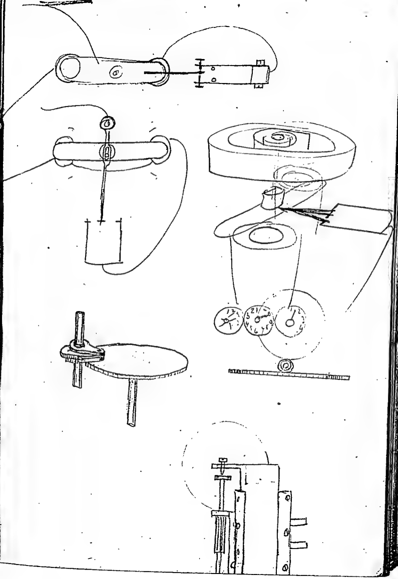
2 1/2
2 1/8

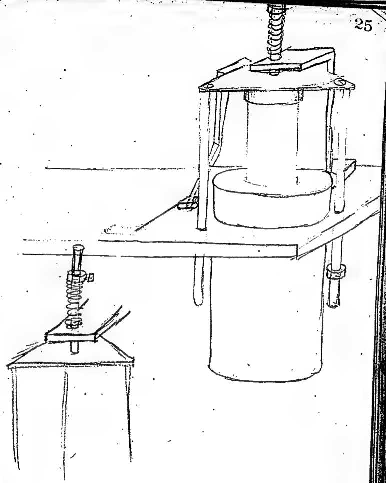


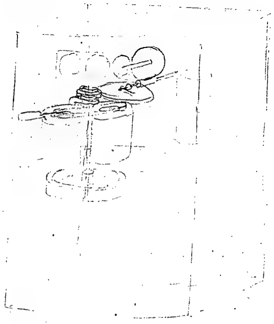




Meter

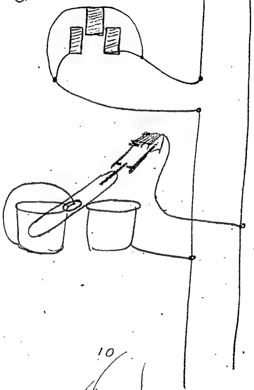






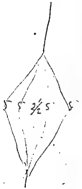
37

Meter Jan 24th 1881
Chas Batchelor



5'0

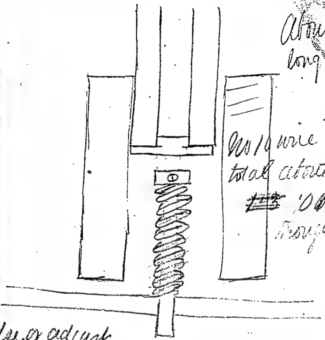
6
1
5



2½

1¼

1¼



About 8in long

No 10 wire
total about ½
.006 ohms
through all

Use or adjust
a spring for each different
number of lights

12 | 768 / 64 | 1896

160 / 1000 / 160

40 threads

large.

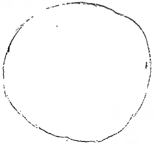
If 2 inches and 3 layers '03½ ohms

Inside less '03½ ohms.

'033

'033

1896 | 6400 / 3688 / 7120 | 0'03½



100.
25

495
76
24
600

0·21

434 000 | 916 8000 | 0
·42000

154

·5
3.14
15.70
3.14

8 9
59
30.

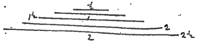
59
18
7.
3/45.

3/44
1/26

157

154
628
785
7

2·5
344
100
25
75
7.850



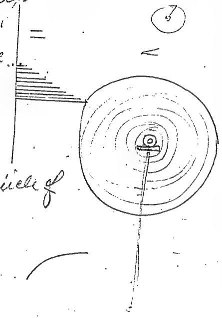
·656
115
3280
656
656
·75440
7

·464
345
3770
5278
2262
282.750
565

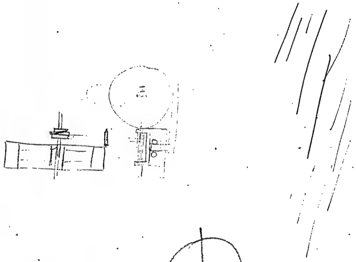
Meter

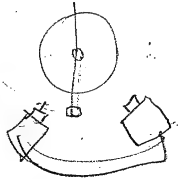
each lamp
must put
an increase
of register

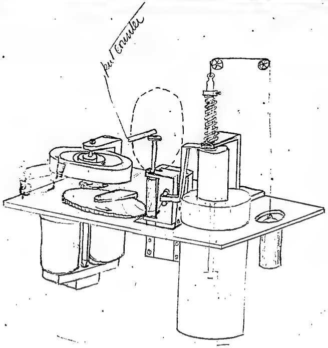
.20
3.14
.6280
3.14 | 1.25600 | 0.4
1 2560



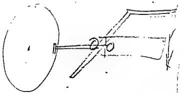
Start with a circle of
30 amperes.



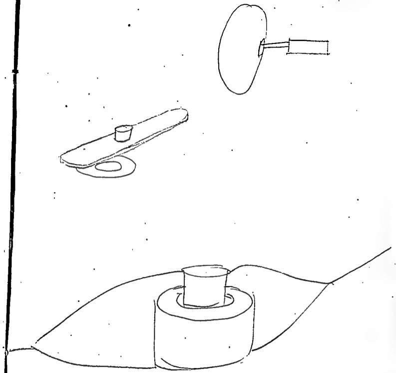


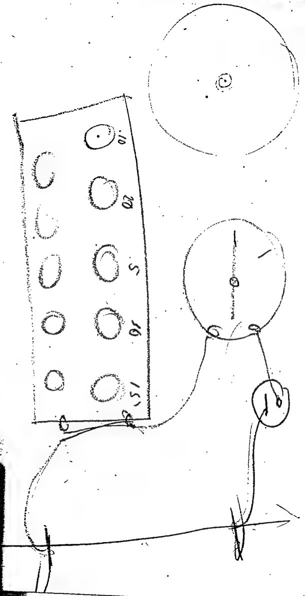


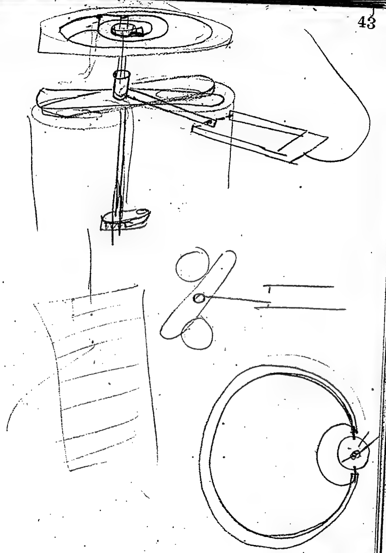
Coils.
Spool.
Break piece

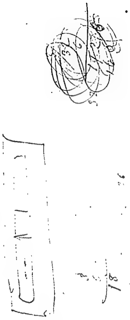


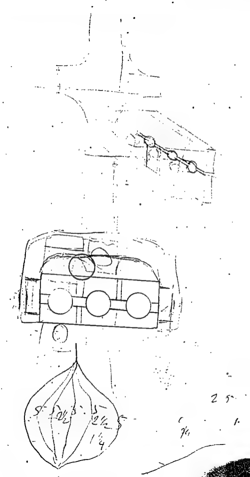
*

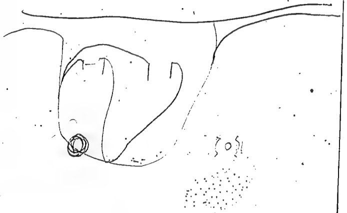


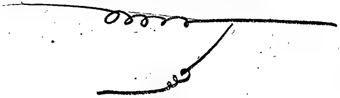

10
20
5
10
15

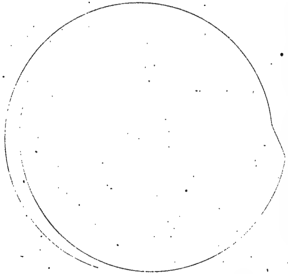








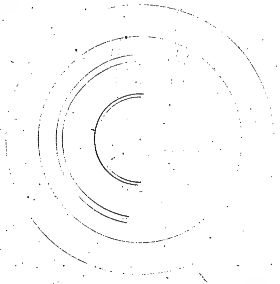




3

4,800

100



~~[illegible] co~~

~~R[illegible] 5 [illegible] 15 in Com~~

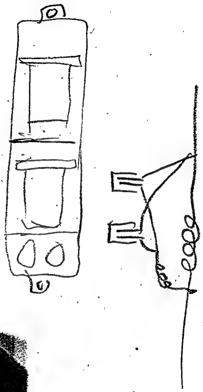
169½ inches No 21 B.W.G. German Silver Wire to the ohm

Re coil 5 in diam 15 in circum, one foot long 8 turns to the inch 1440 inches

1440 inches give 10 ohms

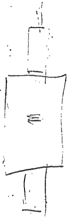
96 turns

16 ¾ ins wide 13 ¼



6 5/8

16

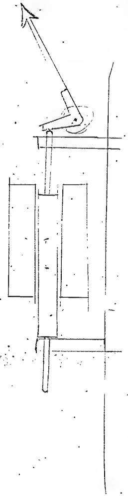


6 1/4
7 3/4
———
14

5 3/8
7
———
12 3/8

1.6

1111



2 5/8

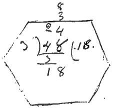
3/8

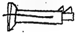
2/8

4/8

$$\begin{array}{r} 8)\,14\,(1\ 6/8 \\ \underline{8} \\ 6 \end{array}$$

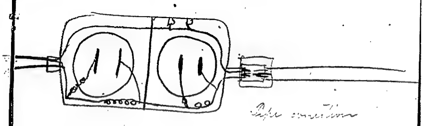
3 3/4





Feby 28 1881

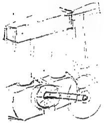
TAE

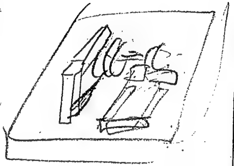


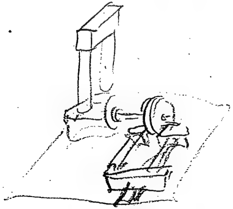
No 26 50 feet .01594 diam

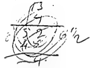
March 7: 1881

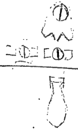
T.A.E.

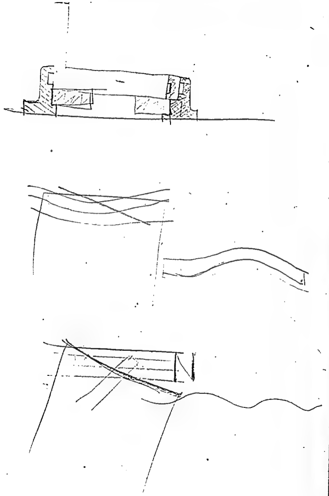


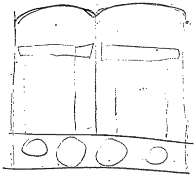


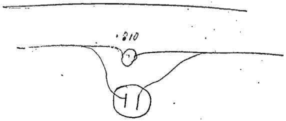


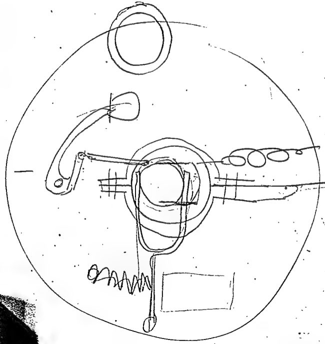


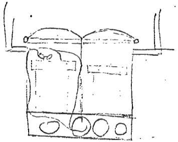


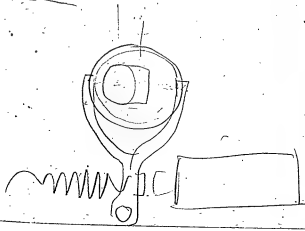


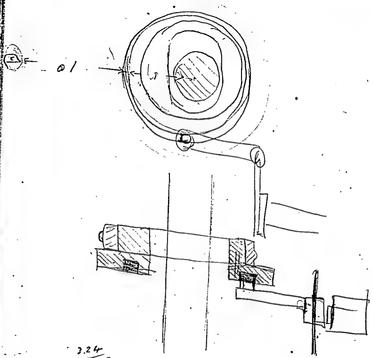



310





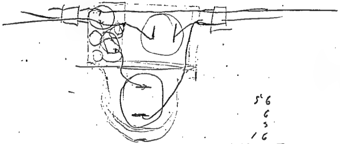




3.24
10.0

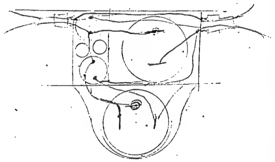
28
2
56
12
68

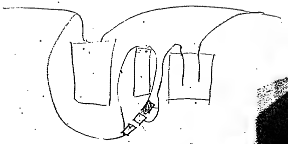
6

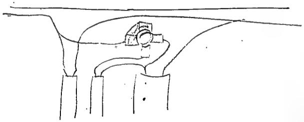


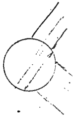
56
6
3
16
81

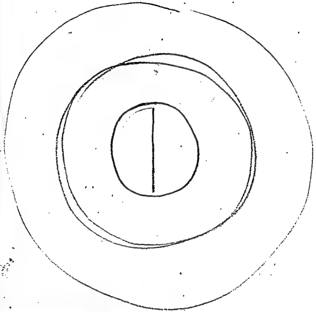
28
3
84

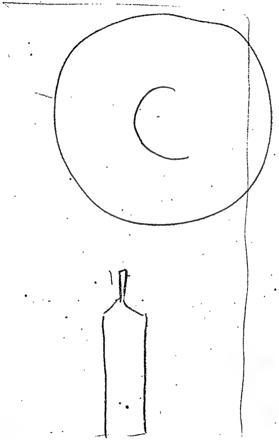


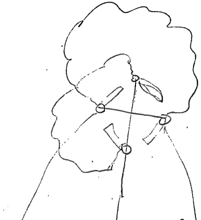




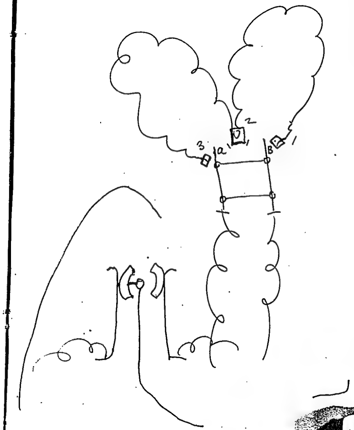


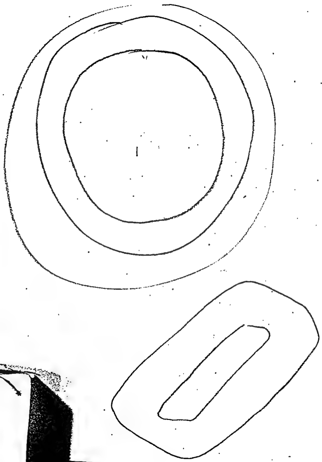


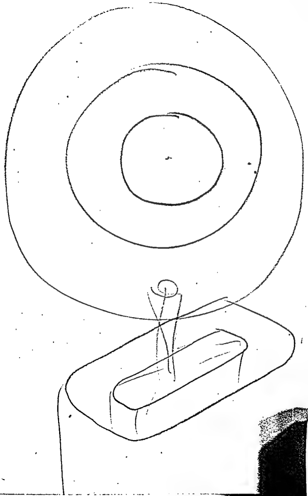


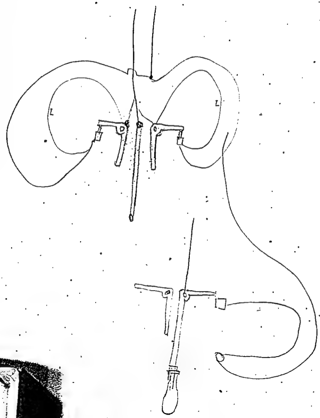


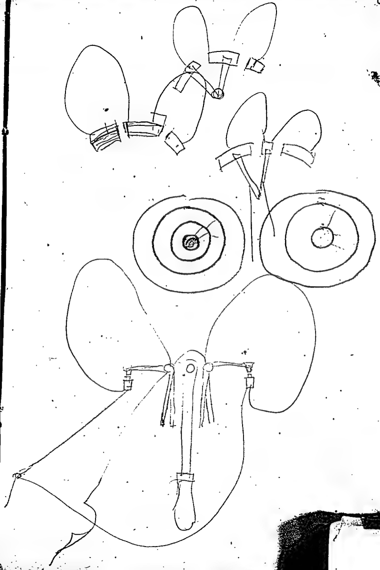
Suppose A on 2 – B on 1
A must touch 3 before leaving
2 and also before B leaves 1
A must leave 2 just before
B touches 2 and B must
touch 1 and 2 at once.

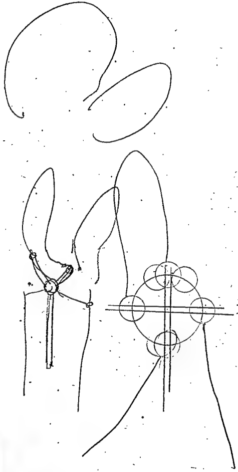


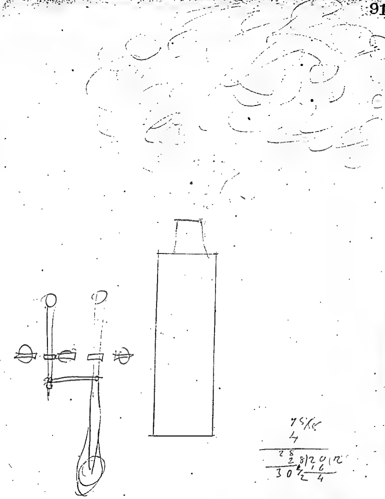












7 5/18
4
28
2 8|20|12
30 1/2 16
4

22 2 3/4
16
26

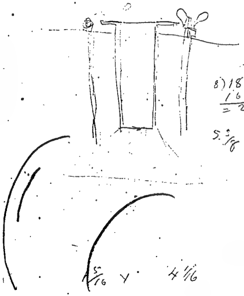
5 3/8

7
1 1/4
8 1/4

7/8 x 1 4/8

7/8

13/16   4.5/8



8)18 3/32 (2
16
= 2

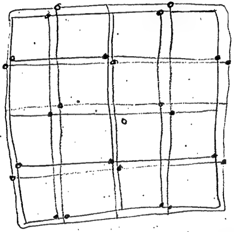
5.5/8

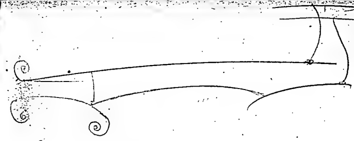
7

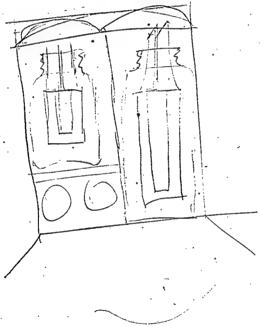
8

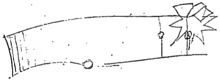
5/16 x 4 1/16

2 5/16 x 7 3/16 = 11.1/4









15
15
60
12
10 9/16 | 1.80 (8 2 4/8 1/2
16
20
16

15
3
45

376
3 1/16

500 x

35
3
105
50
5.200

.400

.035
150
1750
35
.5.250

.04

.04
150
600

10 11/16 10 1/2 10 11/16
10 7/8

1,070
600
50) 470 (9
450
= 20

$10\frac{11}{16}$ .880

10070 5250

$$\begin{array}{r} 10700 \\ 5250 \\ \hline 50\,)\,5450\,(10 \\ 50 \\ \hline 450 \\ 450 \\ \hline \end{array}$$

0 650

$$\begin{array}{r} 109 \\ 50 \\ \hline 5450 \end{array}$$

$$\begin{array}{r} 10700 \\ 5250 \\ \hline 50\,)\,5450\,(109 \\ 50 \\ \hline 450 \\ 450 \\ \hline \end{array}$$

250

$$\begin{array}{r} .0253 \\ 150 \\ \hline 12650 \\ 0253 \\ \hline .037950 \end{array}$$

37

$2\frac{5}{8}$ in side copper

$3\frac{1}{8}$ 1/2 space

$3\frac{1}{2}$ 3/32 Copper

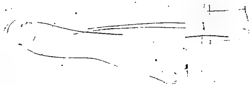
$3\frac{3}{4}$ = rods

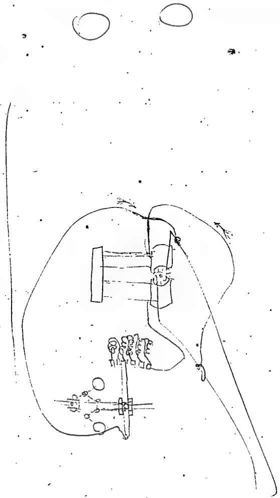
4 inside jar

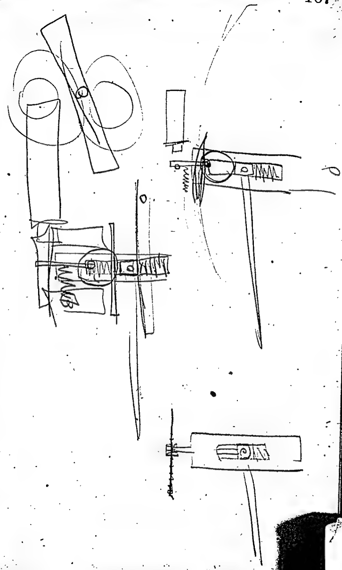
$4\frac{1}{4}$ outside =

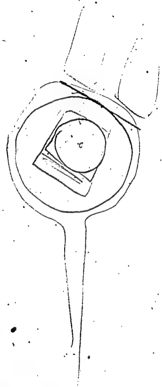
$4\frac{3}{4}$ rubbers

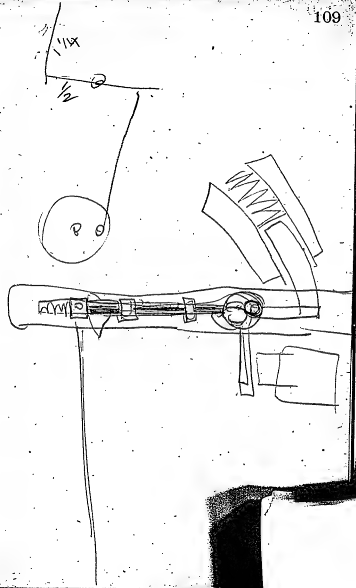
$5\frac{1}{2}$

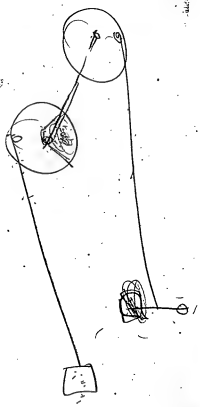


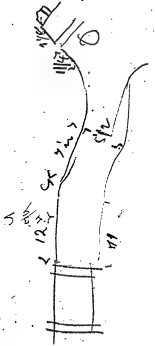






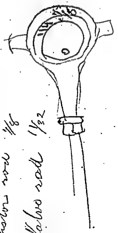

1/2



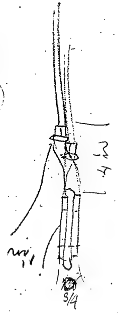


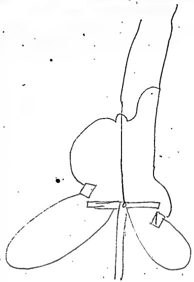
Connecting rod

Spring 1/4 square steel
1/2 in spiral

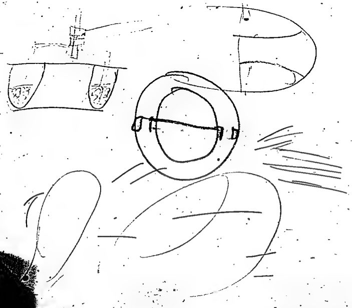


Piston rod 7/8
Valve rod 1 1/32



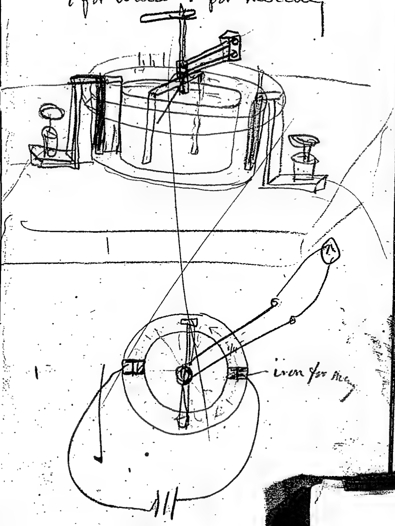


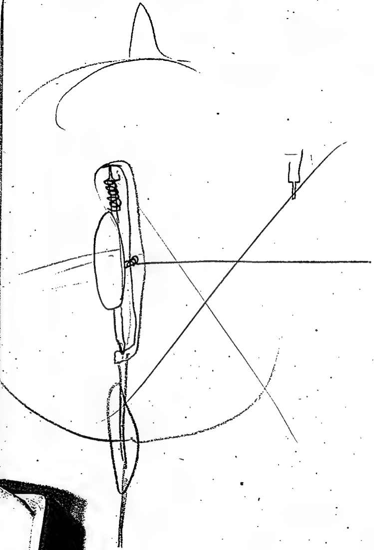
diameter
5 or 6 inches —
2 inches high.



Current Regulator 2

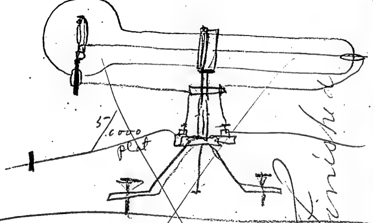
1 for Water 1 for mercury



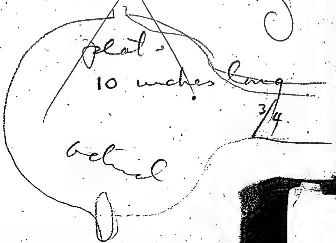


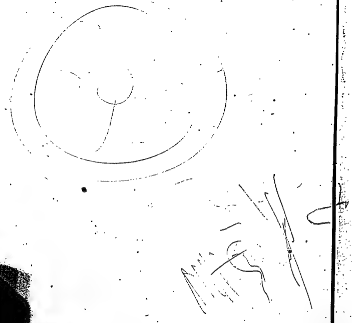
Thermo Galvanometer

one —

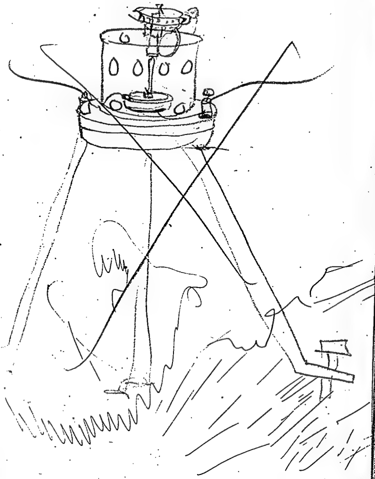


plat -
10 inches long
3/4

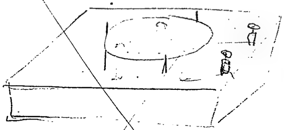




Odometer -

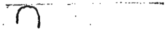


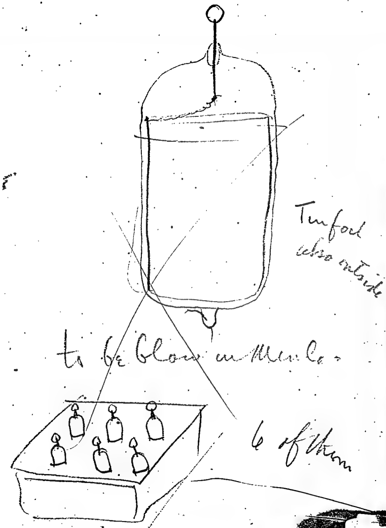
Made this

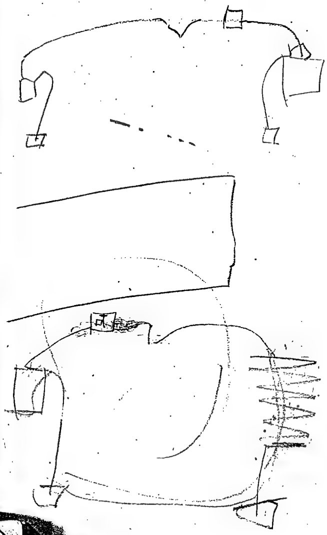


~~Sounding box~~

pillar one in high

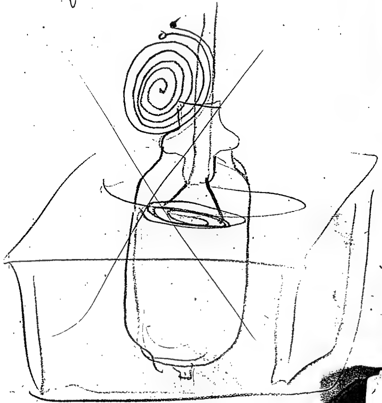



Tinfoil
also outside
to be blown in Menlo
6 of them



Condenser -

3 or 4 feet of tin
foil & Mica

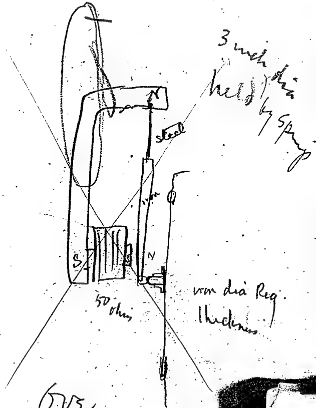


12) 56 (5
 ...
Treasurer

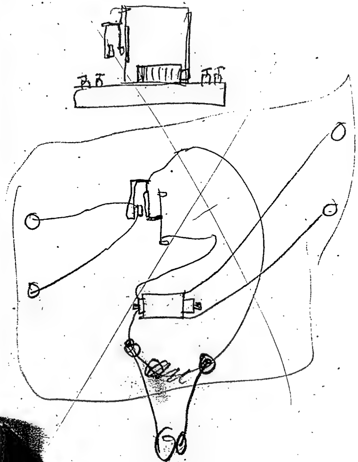
R. boy

28

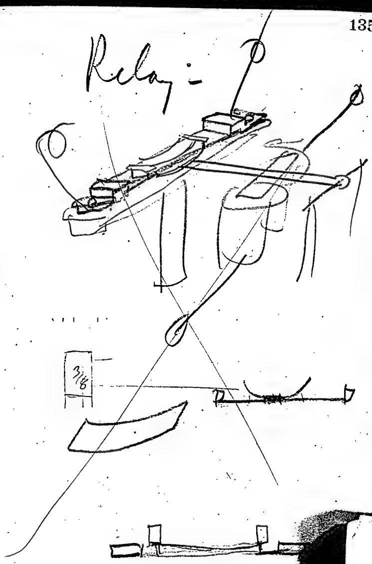
Telephone Repeater

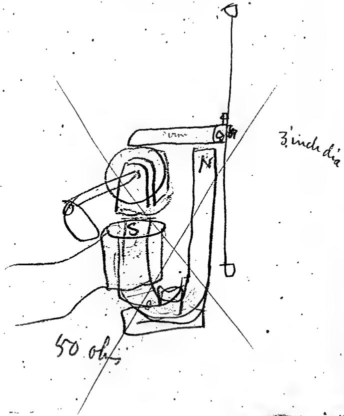


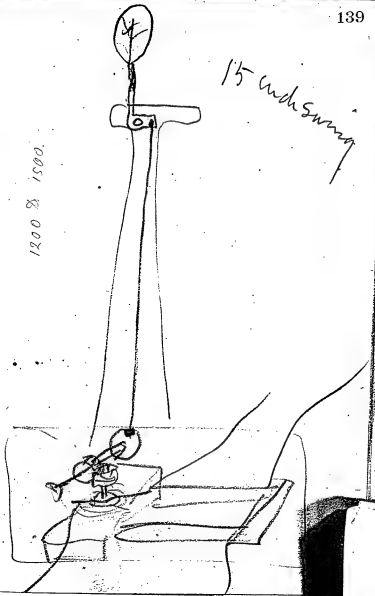
Over



Relay —




N
S
3 inch dia
50 ohms


15 inch swing
1200 & 1500

Dam 3.2 x 5,8 Grote flue

Groote 15, 56 lang

flues 15 x | flues 15, 2 5/8

3

54
3
162

52
5
260

52
3
156

208
73
624
1456
12)15184(1265 4/12
12
31
24
78
72
64
60
4

162
73
486
1134
12)11726(9
108
92

156
73
468
1092
12)11388(948
108
57
48
98
96
2

6.3 7/8
12
72

17

12
3
36

5.2
4
208
72
416
1456
12)14976(1248
12
29
24
57
48
96
96

24
3
72

1248

5

12
4

12
5
60

12'.00(3.5
64) 300

600 10
6000

50) 6000
120

19.1.4

5T

No 19. R 5,8599

16
2
32

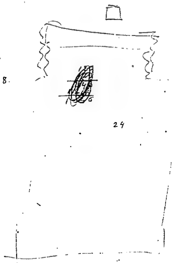
8

32
60
1920
12
3840
1920
23040

24
60
12) 1440 (120
12
24
24

12
5
60

12) 1920 (16.8
12
82
72
100
96
4



24

.42
5
220

1000
220
5) 780 (156
5
28
25
30

170.6

8 in 32
63
96
192
12)2016(168.
12
81
72
96
96

13
5
65

32
65
160
192
12)2080(173.10 in
12
88
84
40
36
10

one ohms resistance 8 in square 13 in long

4 ohms resistance 15 in square 30 inch long

16

32
4
128
260
7680
256
12)33280(2773 4 in
24
92
84
88
84
40
36
4

13
4
52
5
260

4

24
5
120

15

60

120
60
12)7200(600
72

173.10
4
692

30
5
150

150
60
12)9000(741 8
84
60
48
12000
12
6.82
682
59

65
60
12)3900(325 30
36
30
24
60
60

52
4
208
72
416
1456
12)14976(1248
12
29
24
57
48
96
96

54
4
216
32
432
1512
12)15552(1296
12
35
24
115
108
72
72

24
3
72

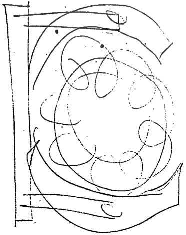
19941
12
39882
19941
2)239292(
119

15050
12
30100
15050
180600

1.14.54
12
23008
11454
137548

12
6.33 3/8
72

54 x 24



208
75
1040
1456
12)15600(1,300
12
36
36

14. 1.5050
12
30100
15050
2)180600(
9.0300

15. 1.9941
12
39582
19941
2)239292
1,19646

16. 2.4466
12
48932
24466
2)293592
146796

95
5
475

1000
475
525

1,14 S.

13.7448

6 1/2

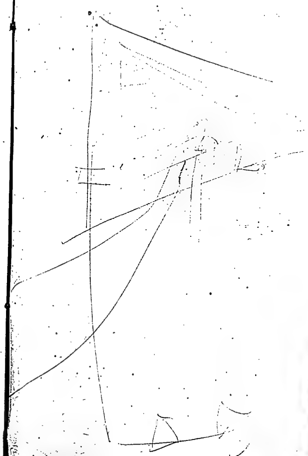
3 1/4

 35 32

92

84

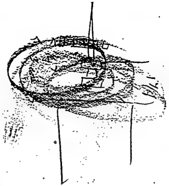
1 1/2 2 3/4



112
20
2280
50
11405.0

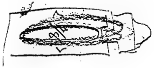
12
3
36
4
40

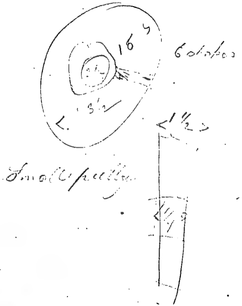
50) 2280 (4.4
200
280
250
30
20

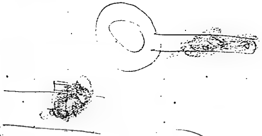


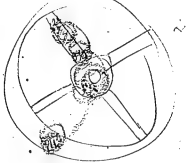
Walnut nook con

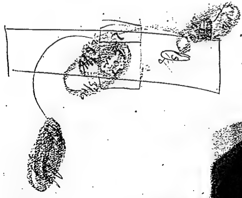
Corn

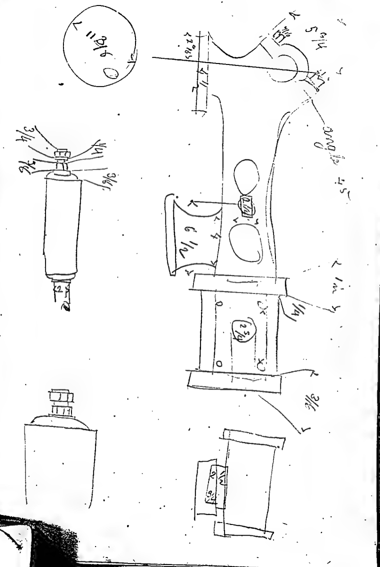



16
6 spokes
3½
1½
Small pulley

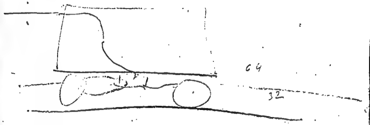



spokes





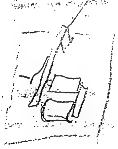
352
16
2112
352
5632



16
12
28
2
56

3.7 7/8

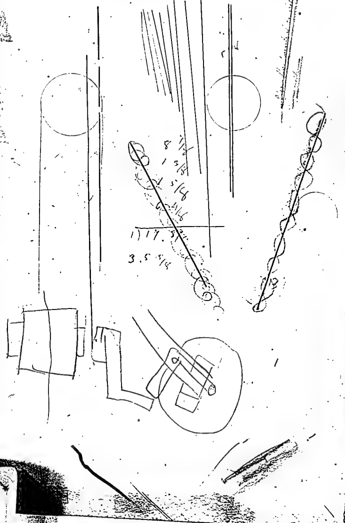
$9)\,352\,(39$
27
82
81
1



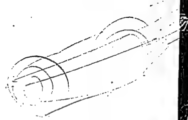
$8)\,352\,(44$
32
32

$10)\,352\,(35\,2/4$
30
52
50
2

Sam E. ~~Mother~~ ~~Brother~~ Sister } one
½ Rood's Uncle



Top	Botom
1	2
3	4
5	6



Menlo Park Notebook #188 [N-81-01-25]

This is one of six notebooks that were probably begun on January 10, 1881. It contains notes on gas lighting and electricity by Charles L. Clarke, which appear to be related to Edison's proposed book on electric light and power. (See Menlo Park Notebook #184.) There are also notes on generators and conductors and eight loose pages that relate to "proportioning the cost of conductors." The label on the front cover is marked "C. L. Clarke." This book contains 284 numbered pages.

Blank pages not filmed: 1, 46-277, 280-284.

Notes on Gas-Lighting.

Consumption,

Rates of-

See Modern Street Lighting by Sugg-

Curves of —

Rate per lamp per hour,

Rate per lamp per quarter,

Hours of burning per quarter,

statistics upon street lighting at Nottingham and Folkstone.

Plot curves for book.

Not Wanted. Data are only upon street lamps.

<u>Wanted</u> - Curves of daily consumption as to time and amount.

Ridicule.

Bessemer process.

Jean's Steel.

page 54 & 5.

" 65

Entire chapter complete with facts of this nature.

Krupp's steam hammer

Jean's Steel,

page 190.

Refusal of Patent
on the most-general
grounds.
Siemens regenerative
furnace.
Jeans's Steel.
Page. 104.

Obstruction of Light-
by globes of different-
materials and clear
glass. Table of -
Gas Engineer's Almanac
by American Meter Co.
1880.

Mixing with air.
Effect of -
Table of per cents of
mixture and loss of light.
Gas Engineers' Almanac
Two tables, American Meter Co.
1880.

Illuminating Power
Loss of.

By deposit of hydro-
carbons in the mains
in cold weather.

Statement Gas Engineers Almanac.
only, without American Meter Co.
table. 1880.

1 3 5 7
1 4 9 11

Standard Gas Burner.

16 candles - 24 holes.
3 inch flame
7 x 1 3/4 proper chimney
5 cu. ft. per hour =
16 sperm candles, 6 to 1 lb.

Residual Products.

Birmingham Gaslight and Coke Co. in 1874 up to June out of a total receipt of 80,000 l. obtained 7000 l. from residuals and needed but 9000 l. to declare a 6 % dividend. Thus 7/9 of the sum was obtained for this half yearly dividend.

Vol. 18, p. 300. Engineering. Oct. 16, 1874

Total London Companies in 1873
Total received for gas

2504402 l.

For products, ammoniacal liquor, tar, coke, and breeze

950 000 l.

Gas per Ton of Coal.

London Companies in first half of 1874 consumed 236581 tons of coal, producing 2300386000 ft. of gas or 9723 ft. per ton.
8634 were actually consumed, the remainder being lost in leakage or consumed on premises. Ordinary Coal used.
Engineering. Vol. 18. p. 305. Oct. 16. 1874.

Total Coal in London Companies in 1873 - 1430931 tons costing 1753715 £. Gas sold 12,248,643,300 cu. ft.
Engineering. Vol. 18. p. 72

Leakage

See page 20.

Capital Invested.

London
10032955 Z. of which
8 3/4 millions are paid in.
in 1874. Engineering Vol. 18. July 24, 1874

Deterioration of Coal.

Coal deteriorates by exposure to air and moisture and causes serious loss. and companies cannot hold large lots.

437½

7000) 17000
2430

Philadelphia

Report of Trustees of Gas Works. 1880.

No. of Lights	No. of meters	Total Lights.
3	50801	152403
5	26584	132920
10	13157	131570
20	4112	82240
30	927	27810
45	474	21330
60	228	13680
100	328	32800
150	42	6300

Lights	Sq. root of total lights	Sq. root of meters	Per cent of Total %
3	390	225	25
5	364	163	22
10	362	115	21.9
20	287	64	13
30	167	30	4.7
45	146	22	3.6
60	117	15	2.5
100	181	18	5.6
150	79	6.5	1.7

Field of Force.

Speak of the importance of running close to face of field as possible and give calculations on the actual effect of such a change. Make comparison of the relative commercial advantages of getting requisite E.M.F. with high or low internal resistance. For example, as a particular case, is it more economical to make the machine 15 to 1 to get the requisite E.M.F. or give more room so as to get 30 to 1 and obtain the same E.M.F. by strengthening the field by enlarging the magnets and copper?

Draw curves showing for a desired E.M.F. where commercially is the limit of energy which can be permitted to excite the field when compared with the weight of iron and copper, which can be increased in order to decrease the energy expended in exciting the field.

The reason why permanent magnets are not used, the investment would far exceed the cost to excite and electro magnet, when that cost is capitalized.

Magnet Tests.

Select three magnets which have recently been rewound, and have fiber washers on the ends of the core, and accurately measure their resistance

Start in the experiment by throwing out the field and then strengthen the field gradually, taking the deflection for every few degrees so as to get points sufficiently close to accurately determine the curve. Take the deflection from terminals of magnet & machine, and measure the resistance of armatures. After the field has been thus run up, bring it down

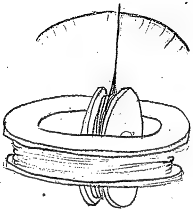
gradually taking the readings of the galvanometer as before. Take all the readings to right and left.

2nd Set of Exp.

If dynamo is not giving over 100 volts put in the external circuit a resistance beginning with 1.5 ohms, as near as convenient, take the deflection around the terminals of dynamo, Vary the resistance increasing it to about 13.5 ohms and note the deflections, keeping the field constant. Do this for the three machines.

3rd Set of Exp.

Electric Dynamometer.



Try

Impossibilities,

W. H. Preece in Engineering
Vol. 27, page 81 – Jan. 24, 1879

After a long mathematical investigation he concludes as follows:–

"It is this partial success in multiplying the light that has led so many sanguine experimenters to anticipate the ultimate possibility of its extensive subdivision — a possibility which this demonstration shows to be hopeless, and which experiment has proved to be fallacious."

E. M. F. curves -
John Hopkinson -
Engineering - Vol XXVII.
page 403

By same writer
Vol XXIX
page 424

Conductors. Jan 25th 1881.

The weight and therefore cost of conductors for the same number of lamps varies as the area over which they are distributed. For example :- If conductors for a central station system of 10000 lights distributed over a certain area cost — $60000, the cost for the same number of lights distributed over twice the area will be $120000, for three times the area $180000 and so on.

7/400
5·7

14
5·7
6
77

Proof

Weight of Copper $\propto \overline{\text{distance}}^2$.

area $\propto \overline{\text{distance}}^2$.

$\therefore$ Weight or Cost $\propto$ area.

If lamps are evenly distributed, that is, the same number of lamps for a unit of area the weight and therefore cost of conductors will vary as the area or number of lamps.

Proof Lamps $\propto$ area

but area $\propto \overline{\text{distance}}^2$

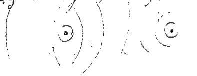
$\therefore$ Lamps $\propto \overline{\text{distance}}^2$

but Weight of Copper per Lamp $\propto \overline{\text{distance}}^2$

$\therefore$ Weight or cost $\propto$ lamps or area.

Wanted.

A diagram showing
the advantage of sub-division
over one central light of
great power, to be shown
by diagram of circles.



Curve of field magnet
3 sizes
Also iron and copper investment.
at 10% interest, Energy line.

[ITEM FOUND IN BOOK]

Proportioning
the
Cost of Conductors
so that the
Interest and Depreciation
on the
Cost of Conductors,
and
Power-Producing Plant
and,
Loss of Power
shall be a
Minimum.

No. of lamps + size of district const.

x = Capital Invested in Conductors.
m = % interest on same.
n = % depreciation.
a = cost of producing the energy developed in the lamps.
y = loss in conductors.
z = ratio of resistance in conductors to resistance in lam

Proportioning the cost of conductors so that the interest and depreciation on the cost of conductors and power-producing plant and loss of power shall be a minimum.

Number of lamps and size of district constant

x = Capital in Conductors – variable
m = % interest – constant
n = % depreciation – constant
~~AK = cost of energy in lamps const.~~
A = the amount of energy constant, meaning fuel, ie &c.
z = ratio of resistance in conductors to the resistance in lamps. variable
AKz = Cost of energy lost in conductors.
Az = the amount of energy lost "
K = Cost of fuel &c per unit of energy variable

[ITEM FOUND IN BOOK]

The actual cost of energy in [illegible]

$T = (m+n)x + wA(1+z)(t+u) + C(q+r) + S + s + AK(1+z)$

differentiate and place $= 0$

$(m+n)dx + (t+u)wA\,dz + ds + A\,dK + Az\,dK + AK\,dz$

but $z \propto \frac{1}{x}$

$z = \frac{c}{x}$

$dz = -\frac{c}{x^2}dx$

~~unit of energy ∝~~

~~Cost of unit of energy ∝ K~~

~~but =~~ $\cancel{w \propto A(1+z)}$

$w \propto A(1+z)$,

$wA(1+z)$ = capital invested in power

and $AK(1+z)$ = cost of that power

Let the ratio of capital to cost be R

then $\frac{w}{K} = R$ a constant

Total expense

$T = (m+n)x + (1+z)a + w(t+u) + C(q+r) + S + s \quad (1)$

in which x, z, a, w, s, are variables,

differentiating and placing equal to zero

$(m+n)dx + da + a\,dz + z\,da + (t+u)dw + ds = 0 \quad (2)$

$a \propto K$

$\therefore a = AK, \quad (3)$

$da = A\,dK \quad (4)$

also

$z \propto \frac{1}{x}$

$z = \frac{c'}{x} \quad (5)$

$dz = -\frac{c'}{x^2}dx \quad (6)$

$w \propto A(1+z)$

$\therefore w = c''A(1+z) \quad (7)$

$dw = c''A\,dz \quad (8)$

$S \propto A(1+z)$

[ITEM FOUND IN BOOK]

c = Capital invested which would not be altered by change in the amount of power produced, as real estate, pipes for conductors, meters, &c

q = % interest.

r = % depreciation.

w = Capital invested per unit of energy which is altered in proportion to the change in the amount of power produced, as engines, dynamos &c

t = % interest

u = % depreciation.

S = Executive salaries and like expenses which do not change with amount of power.

s = wages at stations and like expenses which change with amount of power.

Assume that the cost of plant per dollar of power per year ~~kw~~ $\underline{b}$ and at p% interest and q% depreciation.

Then for the general case:—

$$y = za, \qquad (1)$$

$$z \propto \frac{1}{x}$$

$$z = \frac{c}{x} \qquad (2)$$

$$c = zx \qquad (3)$$

Total cost of interest, depreciation and power

$$C = mx + nb(a+y) + a + y \qquad (4)$$

differentiating we have, placing it at zero

$$m\,dx + nb\,dy + dy = 0 \qquad (5)$$

from 1 and 2

$$y = \frac{ac}{x} \qquad (6)$$

from which

$$dy = -\frac{ac}{x^2}\,dx \qquad (7)$$

substitute this in equ. 4

$$m\,dx - \frac{abcn}{x^2}\,dx - \frac{ac\,dx}{x^2} = 0$$

[ITEM FOUND IN BOOK]

$$\therefore\ mx^2 - abcn - ac = 0$$

$$x = \left[\frac{ac}{m}(bm+1)\right]^{\frac{1}{2}}. \qquad (8)$$

by equ. 5

$$y = \frac{ac}{x}$$

substituting

$$y = \frac{ac}{\left[\frac{ac}{m}(bn+1)\right]^{\frac{1}{2}}}.$$

$$\therefore\ y = \left[\frac{ac}{m(bn+1)}\right]^{\frac{1}{2}}. \qquad (9)$$

by equ. 2

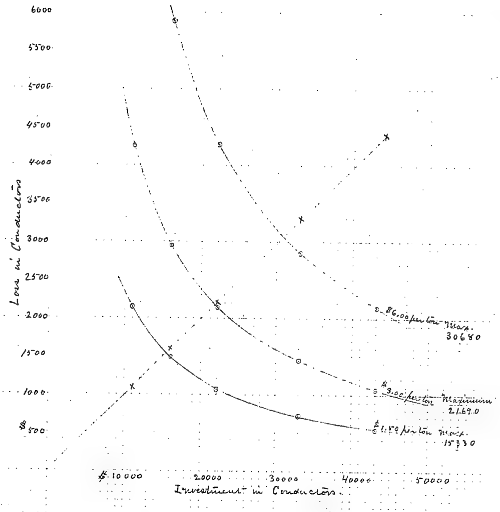
$$z = \frac{c}{x}$$

substituting

$$z = \frac{c}{\left[\frac{ac}{m}(bn+1)\right]^{\frac{1}{2}}}.$$

$$z = \left[\frac{mc}{a(bm+1)}\right]^{\frac{1}{2}} \qquad (10)$$

[ITEM FOUND IN BOOK]



Menlo Park Notebook #189 [N-80-00-04]

This is one of six notebooks that were probably begun on January 10, 1881. It contains essays and notes by Edward H. Johnson on gas and electric lighting and on the nature of technological innovation, which appear to be related to Edison's proposed book on electric light and power. (See Menlo Park Notebook #184.) The book contains 284 numbered pages.

Blank pages not filmed: 32-33, 38-39, 56-284.

Rule for determining Approximately - the No. of Gas jets required in a given room

The floor area in feet divided by 50 for Common Gas (or by 70 for Cannel Gas) will give the No. of burners required for Effective lighting)

Example

Room 80 × 56 = are 4480

$\frac{4480}{50}$ = 90 burners

or

$\frac{4480}{70}$ = say 60 "

~~Gas first put in practical operation by Robt Murdoch of Redruth, Cornwall publicly showed the system in 1797 — in 1798 made an apparatus for the making of gas and lighted neighbouring workshops & stations~~

Opposition to Railroads

~~Ch~~ Amer^n Cyclopaedia

Stephenson

"While this road was building the most eminent Engineers persisted in recommending Stationary Engines in place of Locomotives which they declared unsafe & incapable of attaining high speed; and the clumsy expedient of a series of Stationary machines 1½ m apart dragging the trains by ropes would have been adopted but for the energy of Stephenson and a few of his friends"

Gas

~~Artiz~~ Coal Gas Treatise

~~No 1~~ =

"In our narrative thus far we have described the 1st Ideas respecting gases; the primitive bases of pneumatic chemistry; the earliest recorded production of inflammable air; the spontaneous Emission of Carburetted Hydrogen from the earth & its ignition; the manfr of the same Gas, together with the means of storing it, and on a small scale as a scientific curiosity, its application to lighting. All these had been observed or achieved but there was still wanting the mind to conceive the mode of applying Coal Gas to useful purposes

And the intelligence & carry it to a successful issue,

Use this as an analogy

Also from same paper in the succeeding Paragraph the following:

"WE now pass from the visionary to the real And from the speculative to the positive"

Information ~~now in the~~

NYork lighted with Gas in 1834 - Pha 1835 =

Phil^a Gas works 1880 Valued at 25,000,000. Could not be replaced for much less =

45^d annual report Trustees Pha Gas works

Wilsons "Economiser for Gas Users" =

With ordinary burners instead of getting 15 Candle light from Common Gas, 5 or 6 - Candles is the rule.

In Glasgow where the Gas is exceptionally good 5 or 6 Candles is the rule, instead

of the 27 candles at which the Gas is supplied & instead of the 20 candles that can easily be obtained, the higher the quality of the Gas the greater will be the care required to burn it so as to get all the light out of it without producing smoke." —

further

"In some cases Gas is abandoned altogether and replaced by candles & oil lamps because the simple rules for its proper burning have not been understood."

further

"As the barometer falls the light diminishes and according to Dr Frankland at the rate of 5.1 per cent for every inch of fall according to Dr Letheby in London, the difference in the value of the light when the Barometer is 31 as compared with what it is at 28 is fully 25 per cent"

Thus we have ~~the~~ ~~our~~ Gas ~~artificial~~ light ~~getting~~ ~~weaker~~ reduced by atmospheric changes the same thing may be said of ~~all~~ other forms of artificial light, except Light in Vacuum ~~Electric~~ Light

further

"Practically speaking When Compared with Wax & Paraffine Candles, placed on a table At least 50 % of the Standard Candle Power of the Gas should be deducted to allow for the loss by burners and globes & height from Table.—"

Note The loss in Edison's light by defective burners — no loss by filtering through Glass & globes — because not necessary, & in globes there is absolutely no movement of the light as when a Gas jet is

disturbed by the Air — or When the pressure is such as to Cause it to "blow" = these defects in Gas render it so painful to the Eye that ~~this~~ Concealment by semi translucent glass is resorted to with other result of above loss of light

As to height from Table the E. L. may be used on the ~~same~~ plane ~~of~~ the Eyes since it is so mild & steady as not to be painful

Jeans in Steel

Bessemer knowledge of Iron Metallurgy was at that time very limited but this was a great adv. to him for he had but very little to unlearn & could thus approach the subject free from a bias ch. of those who have long followed a beaten track of routine, endeavored to get out of the Rut."

Page 45

Note this may be said of Edison ~~which~~ in respect ~~to the subject~~ his knowledge

Of the subject of Electric Lighting at the time He began this investigation - He had never given the subject a moments thought or consideration - had not read any of the literature of the subject & was in fact perfectly ~~...~~ unbiased to follow the lines suggested by his own ideas

Wilsons Common Sense

following a table designed to show that Gas is less injurious than Oil Wax or tallow is this qualification

"No doubt these results are correct enough but they are laboratory experiments and when we apply the quantities to actual practice they show that Gas as burnt in the usual extravagant manner is more injurious than any of the other systems of lighting".

This extravagant use of the Edison L— can in no way ~~...~~ create a deleterious

Effect - since none exists primarily -

fourth

"It is a mistake to assume that the quantity of sulphur compounds produced at one burning is infinitesimally small - if this quantity be not removed and it becomes deposited on articles in the room it is only a question of time and number of repetitions for the insignificant quantities to become very formidable collectively."

That gas does injuriously effect Plants, ~~Pictures~~ Paintings & decorations

is well settled - hence although as above suggested the injury may be very small at any one period of time - the cummulative Effect is very great =

The E.L. not only cannot cause any such deposit - but in the Case of Plants is held by certain authorities to be decidedly advantageous

~~viz A Siemens Experiments on the Effect of the E.L. on [illegible]~~

Loss of Illuminating Power

Coal Gas is depreciated in illuminating power to a greater or less ~~extent~~ degree in travelling through the mains & service pipes, owing to the liability especially in Cold weather, of the Hydro Carbons to be Condensed & deposited.

Newbiggings Hand Book

~~Heavy~~ High initial pressure synonymous with a heavy leakage &c

Note on Oppn of
fraternity - professional

The ~~a~~ apparently inexplicable
fact that the highest authority
in any given art is so often found
condemning most vehemently
the infant innovation may
be explained in this way -
Naturally he who becomes the
most thoroughly versed in an
existing method. Who is the most
firm believer in it - who has
the most thoroughly mastered ~~the~~
~~particular~~ ~~method~~ its details
- is vested by his fellows with
the honor of "authority" =
The very firmness with
which he becomes welded
to the existing order of
things closes his mind
against innovation - he
has run so long in a
given groove - that

Opposition

J S Jeans' History of Steel

Ref. to Bessemers Efforts
to interest Iron manufrs
in his new method ~~of~~
making Steel =

Page 54

"One of the 1st to pronounce
decidedly on Bessemers claims
was Charles Sanderson perhaps
the most eminent Steel manufr.
in Sheffield and ~~at that~~
time a leading authority
on all questions relating
~~to the~~ practical manufacture
of Steel. Sanderson freely
admitted that if Bessemers
pretensions could be realized

his invention would take rank deservedly among the first if not the very first of the age - but after carefully examining the claims of the inventor he would not admit them to be feasible. He did unhesitatingly allow that by the Bessemer process a decarburized cast Iron was attained and that such Iron was bright, white and crystaline; but he did not believe that such metal would admit either of being drawn under a hammer or rolled into a bar. He could not admit the Bessemer metal to be cast steel. It would not make a boring tool or a cutter, a tap or a die. It could not be fashioned by the workmans hammer made into a needle or cut into a file; and in short he was compelled to express the opinion that it was a metal which could not assume the commercial value of steel - nor would it produce a malleable iron suited to the requirements of commerce.

Page 55

Truran, whose experience of the Metallurgy of Iron caused his views to be accepted with deference, also took up the controversy. He pointed out that the combination of ~~fluid iron~~ the carbon in fluid iron run direct from ~~the~~ blast furnace and exposed to the

action of a blast of atmospheric air was no new discovery, numerous examples of blast being blown into the liquid iron in the old form of refinery furnaces and the intense heat produced by blowing strongly into liquid iron and adding carbon in mixture or combination was well known to intelligent refiners, so that Bessemer's "assumed discovery" of a great principle resolved itself into the republication of facts that had previously been well known"

Go to Page 30

from Page 18

he cannot get ~~out~~ of it. [illegible] again - Man is always loth to give up authority - hence rather than wish to find good in the new thing & thus invest ~~the~~ another with a vestige of his authority he comes to it with a feeling of antagonism which only absolute conviction can remove - This conviction can seldom be effected in the early stages of an invention consequently 9 times out of 10 the "authority" fails to see what others with probably less repute but without bias at once comprehend

~~It is not the general the~~

~~It~~ Again It not infrequently happens that the "Authority" has been seeking himself to accomplish the same thing but has only in part succeeded. He is then even more than any other man likely to ~~find fault~~ find in the solution offered him numerous defects, absurdities Etc.

It is an open question whether an Engineer in another but Kindred profession is not a more reliable judge of the value of the new thing than one

~~Expert~~ of the same profession to illustrate — would probably be a Gas Engineer is more competent ~~to decide~~ to pass upon the value of a System of Electric Lighting than would ~~be~~ an Electrician & Vice Versa —

Opposition

From the Inaugural addr. of the Presdt of the Brit. ass. of Gas Managers at Bristol Eng. ~~Aug~~ June 12th/77 - as reported in the Amer Gas Light Journal Aug 2/77 -

under the head of "The Electric Candle" (Jablochkoff) a report is given of the failure of an Exhibit of Electric Lighting to Which the Presdt had been invited because of the "break down of a Steam Engine without

Which the Electric Generator Could not be worked," ~~From this the following deductions are drawn~~

~~He says~~: - He says:-

"Beside all which, its cost must be such as to put out of the question its becoming a rival to Coal Gas until some means be devised for collecting Electricity without having to employ steam power for its generation". And again in speaking of the same attempt to exhibit the light. he says "assuming however that ~~the~~ thing

had been a success its superiority over other Electrical Lights would have been a matter of degree; the inconvenience of a light too powerful for the human Eye would still remain & the light from one burner would require to be reduced by shading to about 1/5 of its power to render it admissable for the ordinary purposes of life thus reducing its value while the cost of production would remain the same. It is thus obvious that if the light of

100 Candles be produced & 20 only are available the 80 are absorbed and wasted. ~~And~~ there would always remain ~~the fatal~~ objection of its not being diffusable; beside all which its cost must be such, as to put out of the question its becoming a rival to Gas light until some means be devised for <u>Collecting</u> Electricity instead of having to employ Steam power for its <u>generation</u>."

And from this exposition of the subject as it appears to him the following deductions

to Page 40

from Page 22

Page 56 Bessemer

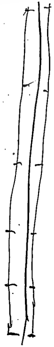
As indicative of the reception
of that the Bessemer
process met with at the
hands of the [illegible] Industrial
Press [illegible] quite a short
Extract from the "Practical
Mechanics Journal" which
asked if Mr was "not
something like a mares nest"
[illegible] that the Iron
may [illegible] it. The Iron
as refined according to the
New process [illegible]
to consist of an agglutinated
mass of large brilliant crystal
grain. Possessed of a very
perfect malleability flatting
under the blow of a hammer
but almost invariably

Cracking at the Edges -
It is wholly destitute of
a fibrous ~~[illegible]~~
structure and only
after having been repeatedly
heated and drawn out in
a Smith's forge Exhibit the
properties of an inferior
wrought Iron

Water Vs. Coal Gas

~~Gas~~ The hope is held out to the Public that a cheaper & superior Gas is to be produced by new processes. But on reference to the general discussion of the subject of the relative merits & demerits of the two it is found that the new gas has two fatal defects ~~first~~ viz: It is a blood poison & by being dependent upon the use of naptha - of which

There is & can be but
a limited supply
- the extent to which
it may be manufactur
is far within even the
present limit of
Coal Gas manufacture



are drawn.—"

"But I think I may safely say that there is not the slightest probability of property invested in Gas undertakings being affected in value by any kind of Electric Light; and that the fear of any such result can only be seriously entertained by the ignorant."—

Comments:—

It thus appears that the most prominent

of British Gas Engineers is found ~~[illegible]~~ indulging in captious criticisms and hurling the terrible charge of ignorance at those who entertain opinions not in accordance with his: He must indeed be a superficial thinker if he really believed the instability of Electricity was fatal to its use— Did he not know that the large Engines of a steamship work unceasingly for weeks at a time during an ocean passage. ~~He~~ If ~~the~~ upon the ever moving wave how

much more constant
upon a solid foundation
~~But~~ And did it
not occur to him
that an Electric light
Station might be
supplied by a number
of Engines as is a Gas
Station with
a number of Reservoirs
so that when any one
became unavailable
another might be
drawn upon - In point
of fact the assumed
insurmountable difficulty
is fully met by the
simple & natural Expedient
of having One Extra
Engine in a station
~~[illegible]~~ of 12 -

If one should fail
the Extra being always
kept in motion could
be so instantaneously
"switched" into connection
with the circuit mains
as to scarce permit
of the lights ~~supplied~~
of such circuit becoming
more than a few
candles lower in
intensity. If a second
or a third should fail
simultaneously ~~with~~
~~the~~ the first the 9
remaining would still
suffice inasmuch
as they would, ~~[illegible]~~
~~[illegible]~~ always
have a reserve capacity

Equal to such Extra drain: & Even if not fully Equal to the task the deficiency would Only appear in a slight diminishing of Each light so slight in fact that it would escape the notice of at least 90% of the consumers & but inasmuch as the power at any station would always be Equal to the demand at that season of the year & at that hour of the night when the maximum quantity of light is used. the coincidental ~~Exceptional~~ break down of 13 Engines would, to tax seriously

the power have to occur at precisely that season & ~~such a time~~ -a combination of improbabilities ~~which~~ ~~and~~ ~~slight~~ ~~results~~ ~~at~~ ~~the~~ ~~[illegible]~~ pregnant ~~with~~ ~~a~~ ~~slight~~ results of little import as to hardly merit a moments thought - much less to be magnified into a "fatal defeat." —

In confirmation of this. attention is called to the rapid supplanting of the Old Reservoir System of Water Supply - by the direct supply maintained by Steam Engines - more

than

Get Hall Water work Statistics

Pressure Regulation

Amer Gas Journal
Sept 3/77

In a paper contributed to the Meeting of the B.A. of Gas Managers Mr W. J. Warner of South Shields gives some interesting data on the subject of regulating the pressure of Gas so as to secure uniformity throughout the service - and then presents some recommendations in respect to a remedy. He shows the pressure throughout the District or town is determined by the Topography of

the district - It is a matter of such common occurrence as to have come within the observation of almost every engineer having to do with high buildings that the pressure is greater at the top than at the bottom of such building - beside these causes ~~of diff~~ due to differences of elevation etc there is that of stoppage by naphthaline -
To determine these differences of pressures Mr Warner would take the pressure "at those positions where the mains are diminished, at the foot, top & up the sides of hills,

along the principal streets and at the extreme ends of the districts"
The Presdt of the Assn. endorsed & emphasized Mr Warner's remarks on the subject in the following words "Mr Warner had dealt with a most impt. subject - He had been personally acquainted with many companies in which a half dividend had been wasted for want of such simple means as Mr Warner had indicated ++ The waste which constantly occurred for want of due regulation of pressure at different parts of a dist. was most serious.
In some places there would be perhaps 3 or 4

times as much as was wanted whilst in others there would be a deficiency. The constant source of complaint & annoyance" =

All this is of course due ~~to the fact that~~ Gas being lighter than Air ~~[illegible]~~ rises with a pressure proportioned to the ~~[illegible] of the column it [illegible] of Elevation re~~ height of the Column & since this varies with the topography of the dist, it follows that ~~[illegible]~~ Each dist must be considered by itself in any attempt to establish uniformity =

~~Although it [illegible]~~ With an initial pressure of 20 inches the pressure ~~the [illegible]~~ at various points throughout the Dist may vary ~~[illegible]~~ several inches

~~Although much has been said about the difficulty of providing ~~[illegible]~~ the Electric light [illegible] with a practical regulator ~~[illegible]~~ ~~[illegible]~~ of the [illegible] [illegible] the invention of the Lamp & the development of the Edison System has so completely removed the matter from the~~

52

~~sphere of importance its has~~ The providing of a practical Regulator for the Electric Light has always been held to be of almost as vital importance to the invention of the Lamp yet we find by the invention of the Lamps and the practical development of the Edison System the matter is taken from this sphere of importance & reduced to such simplicity & efficiency as to be absolutely free from Errors a single one of the

defects of Gas as above depicted - Electricity not being affected by ~~the~~ Elevation or kindred influences ~~and having in fact no retarding~~ and being subject to no other retarding or accelerating influence than the simple resistance of the conducting wires the pressure may be wholly & absolutely regulated & controlled ~~fat~~ the Central Station -

that this is so, and that any change of pressure at the Central Station produces a corresponding

54

variation at every point of the supply mains may readily be proven to the satisfaction of any one, however unprofessional he may be by observing any one or more of the 800 Lamps in operation at Menlo Park. The variation will be exactly the same ~~as~~ ~~is~~ in the Lamps on the Top, side or at the bottom of a Hill and equally in the nearest or most distant Lamp—

~~Of course~~

From this it ~~follows~~ follows of course that the pressure on the Lamps located

55

on the ground floor will be no more & no less than that on those at the highest point in the House

Menlo Park Notebook #190 [N-79-07-12]

This is one of six notebooks that were probably begun on January 10, 1881. It contains quotations and references from technical literature and trade journals on gas lighting and electricity, which appear to be related to Edison's proposed book on electric light and power. (See Menlo Park Notebook #184.) All of the entries are by Edison. The label on the front cover is marked "Small notes - phrases." The book contains 284 numbered pages.

Blank pages not filmed: 8-284.

"The delicate operations on which the lighting of a town depended"

Coplands lecture in B gud G Lighting April 29 1879 in referring to gas

ditto

"The receipts for public Lamps both in London & provinces being rarely more than 5 per cent of annual rental."

ditto "so the gas consumer has 16 candle gas passing through his meter & something like 10 candle gas being consumed at his burners"

ditto Copland –

"The Electric Light has yet many difficulties to conquer which will require an enormous amount of energy & resources."

"It is comparatively easy to kindle a great light, and dazzle the eyes of the multitude & the latter hardly care at present what the light costs, or whether it can be made available for common use"

"The Electric Light if used generally ~~[illegible]~~ & without shades must always be a cold, searching and peculiar illumination"

Hjorth = see if he has any paper in Royal S Cat - L Clarke says he's first make Dynamo self magnetizing field -

In Scientific Amn July 12 / 79 I notice piece taken from Newcastle on Tyne - Chemical Society's Journal Speaks of Swan having lamp on incandescent principle with "Cylinder" Carbon = get original paper - "Carbon pencil" spoken of

Eng pat 2264 - 9ff by E G Grout & R Sennet
by Hydrocarbon vapor around arc Carbons get at - perhaps it is in my bundle -

Average dividends paid on English RR invested 4.16 per ct — Total invested ~~£474,000,000~~, Great Brittian & Ireland 1868. (get later data)

£502.262.887 (actual paid)

Menlo Park Notebook #191 [N-81-01-21]

This is one of six notebooks that were probably begun on January 10, 1881. It contains essays and notes by Edison and Edward H. Johnson on gas lighting and electricity, which appear to be related to Edison's proposed book on electric light and power. (See Menlo Park Notebook #184.) There is also a draft of a letter from Edison to Uriah H. Painter asking him to obtain publications of the Bureau of Statistics, including industrial statistics from the new census. A note indicates that the letter was written on January 21, 1881. The label on the front cover is marked "notes & mem. of phrases." The book contains 284 numbered pages. The pagination is irregular; some page numbers are duplicated while others are missing.

Blank pages not filmed and missing page numbers: 6-7, 28-229, 231-249, 251-261, 263-281, 283.

Opposition to Gas –

= Objection on the score of Shutting off all lights at once – what would become of Gas there being no reservoir

—

Note Edison suggests the reply to this shows the Gas proudly to have held his system as ill digested as Swann – i.e. series – not a practical way – ~~See~~ ~~Pamphlet~~

"A Practical treatise on the ~~science~~ ~~& Practice of the~~ manufr × Distribution of Coal Gas"

~~[illegible] 1876 – Page 4~~

Page ~~18~~

2

Quote from above work
a Ref to proof of pract-
ability of Gas —
make Analogy to Edison Lite
Page 20 ~~[illegible]~~ line
4th Paragraph

~~Quotations re Reports~~

~~Early~~

Information

Gas 1st applied to useful purpose of Lighting by Wm Murdock Ayrshire Eng.-

Discovd it in 1792

applied (this House) 1797

Public Display 1802

1st Lighting of Sts by Gas Pall Mall by Winsor 1807

~~Westminster [illegible] 1814~~

1st Public Co formed in 1810 in London - by F. A. Winsor "Gas Light & Coke Co"

" Even the best Engineers at ~~the~~ time thought that ~~to~~ operate a Locomotive it was necessary to toothed driving wheels running on toothed rails and innumerable patents ~~were~~ taken out + schemes proposed for overcoming this imaginary difficulty " Chambers Encyclopda.

" It is shown in this as in the analogous case of steamships that the world may remain sceptical ~~long~~ of an invention long after it has been practically Established beyond cavail -" (RR in Chambers Enc)

See Newbigging handbook pages 139 also 121 + 120 = size of pipes required pipe a house without different lights - then get Morris Taskers price list and get cost sample house - then do same on our System, then Show that yearly increase in gas Consumption is so much (get from Phila + London Cos report + assume it for all Country) + thus show annual saving that will accrue to public -

for. Electric Engrs book -

Copy handy rules Newbegging
Handbook page 145 =

ditto. Loss light by globes.
144 = of Newbegging

also table = Newbegg-
p 151 - Comparative Cost
different Illuminants -
adding our Kerosene,
This table also to go in
~~prospectus~~ book
~~substituting~~

Prospectus Co-ak -

Vitiating Effects def ill agents.
p 152 - Newbigging Handbook.

---

also Salubrity - page 152
Newbigging

"Structural Value" has reference
to the amount of Capital expended
upon works in their construction -
"Commercial Value" is the Value
of the net annual average
profits reckoned as a number
of years which a firm or Co
can make by the use of their works.
Newbigging 169 -

7[?]

Nunkeqqang 169 = Good

The average cost of gasworks in provincial towns about £1 per head of population in very large towns amount to more; and in small town want as ... that sum.

Average cost gasworks per Million Cubic feet gas produced per annum is from £700 to £800.

Population per mile of main is usually 2000 people in densely populated towns will rise to 3000 people, but in fashionable places where houses wide apart population per mile of main will fall below 1000.

Average consumption gas per mile of main is from 2¼ to 2½ million Cf per annum

EL Engineer Hand Book

a good Collector will deliver on an average 400 gas bills per day

Books required in system:

General Ledger.
" Cash Book
Consumers Ledger
Large Consumers Ledger, handier to keep them by themselves

Removals Book - In this book is kept an account of all changes residence consumers during each quarter = the substitution meters ~~Conn~~ Candle power used by temporary Consumers, ~~this~~ book prevents confusion by interlineations in reg register

over

Daily Recept book (cash)

In which are entered amount Each separate payment made to Co on account Light p

Black book - record of bad debts.

Balance books:

See 171 Newbigging -

The amount of gas consumed in London for Street Lighting is less than 10 per cent of total sales (see of the '61 '52)

In Salford Eng — only 6 @ 7 per cent & if you add large public works then won't come to 10 p.c.

get other data on this subject,

Thos Newbigging Presdt of the Manchester Dist Institution of Gas Engineers says that the lowest computation there is Expended on gas undertakings in the United Kingdom no less than £60 000,000. Representing an investment of not less than £110,000,000.

Get statistics & notes to
make up this -

The following Eminent men
opposed RR.

ditto Steamboats,
Atlantic Cable

Telegraph
Bessemer
Gas.
Electlight =
& other industries

4.000.000.
390 000
4.390000
17.216000
3.400 000) 21.606,000 (6,30
20400 000
1,206,000

Miscellaneous

Quote from Pamphlet
"A Treatise on the Science & Practice of the Manuf & Distribution of Coal Gas
No 1
Page 28-

"The Indispensable requirements for the manager - or more properly speaking "Engineer", of such an undertaking were good Mechanical Knowledge and Skill some acquaintance with Physics generally - an inventive mind together with indefatigable Energy & perseverance, No mean combination of qualities at any time, but at that period exceedingly rare

And unfortunately for the success of the Co the directors did not understand these qualifications to be essential in their Engineer - So their Choice for that Post fell on Clegg a Chemist to be aided by [illegible] a practical mind - Some reason may be assigned for the appointment of the former but it must be doubtful whether the numerous inventions of [illegible] & [illegible] could be of much assistance in the laying of mains & pipes"

Apply to Telephone Engineer

3 light	152403
5 "	132920
10 "	131570
20	82240
30	27,810
45	21330
60	13.680
100	32800
150	6300
200	2000
300	6300
500	5500
1500	3000
2000	4000
4000	16000

215,260
82.240
133,020

416,893
82240
499133

.500
133

21
300 light
6300

10
200 light
2000

3 light
50.801
3
152403

26584
5 light
132,920

11
500 light
5500

1500 light
2
3000

13157
10 light
131570

150 light
4
600

2000 light
2
4000

4112
20 light
82240

328
100 light
32800

228
60 light
13,680

474
45 light
2370
1896
21330

927
30 light
27.810

4 of 4000 light
16000.

530.000) 2.180.000 Ms (4
2 120 000

25 c Labor

530 0000
25
265 0000
1060 000
1.325 0,000

530 0000
25
265 00000
106 00000
132,500,000

1.892 000) 2.180 000 (1.
1 892 000
288,000

282

WMP

Get all the Publications
of the Bureau of Statistics
— If any Statistics in
the new Census have
been prepared (Industries)
If [illegible]
On [illegible]

Written Jany 21/80

250 000
300

8 / 75,000,000
937,250
300

3

8 ..

20

18 000 000
10.

ms

532 000) 2,180 (000
1 596 (3 4
584.

8

9000000
2500

45 00 000 00
18 000 000
2,25 000 000

8 000000) 3 000 ~~000 000~~
3000
4 000
12,000,000

Menlo Park Notebook #192 [N-78-12-15.2]

This notebook dates from December 1878. All of the entries are by Edison and relate to work on the electric light. There are notes on carbon, platinum, and other materials; calculations and notes on gas, including comparisons of calculations made by Moses Farmer and Edison; notes and drawings relating to electric power distribution and the need for high resistance lamps; and drawings of lamps and generators. The label on the front cover is marked "short notes - phrases" [crossed out]. The book contains 59 numbered pages.

Blank pages not filmed: 55-59.

Notes

Experiments.

Try fusibility of pumice stone, also of Electro silicon, also oyster shells,

Plaster Paris — 1 pt to $2\frac{1}{2}$ H_2O,

Make ~~Hat~~ Lampblack from napthaline =

Dolomite, has been used by Crookes for Cylinders in the Oxy Hydrogen flame, it doesn't Splinter, or Crack like Lime or magnesia

Farmer Edison
1500 540
750 270
325 135

15
36
90
45
5 ~~45~~ 0

7) 135
18

3/3 7

10 1/2 6/16 3/4
5 1/4 12

7) 325
46

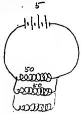
3/16 21 feet 20 6 63 — 3/4 6/8
20 31 1/2 1 1/2
3/8 10.6 1 1/2 15 5/8 3
5.3 7 . 6
3/4

1 1/2 2.7 inch
3/8 1.3 1/2
6 15 1/2
7 3/4

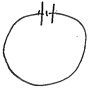
Wilds Mach

7 horse power heated red hot wire No. 16. 21 feet long - surface I calculate to be about 6 x 7 3/4

J. fig 1 1/2 gas jets per hp - with Farmer
100 cp per inch 3 gas jets per hp



.2 ohm



1 ohm

1000, 6 cells;
4000, 12

12 cells,

4 4 ohms

50,-

25 5

1000,

24 58

12 cells, each .333. .4 ohms.

1 coil ~~co~~. 100 ohm. ~~4~~000 fahr

2 – $\frac{100}{3}$ +00 = 50, 1000 each.

24 cells, — 2 coils each, 4000 deg
8 ohms,

40

12 cells – 4 ohms,

cold

25
25
12½

4 at 25, 4 at 25 each – 6 ¼ ohms

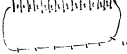
4 at 100. 25 – 1000 deg

8 " 12

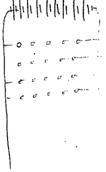
16 6.

1	100
2	50
4	25,
8	12½
16	6¼.

100 cells. 100 ohm



100 - 8 ohm lamps,



1	1000
2	500
4	250
8	125

10 lamps in 10 series,

10	10000
20	5000
40	2500
80	1250

1	10000
2	5000
4	2500
8	1250
16	625
32	312 ½
64	156 ¼

40:

8

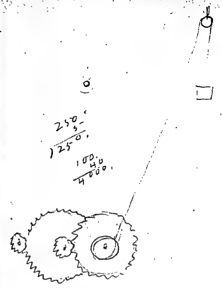
64
50
45
40
35
30
20

300
15,000

11

If you have 100 Lamps each of 1 inch radiating surface and each of a resistance of 1 ohm all connected in series and to a battery which will keep them incandescent then you can make 100 lamps of 100 1000 or 10000 ohms resistance arranging them so the ~~ss~~ Carbon resistance of the whole equals that of the 100 1 ohm lamps in series and the result will be the same but for general lighting the high resistance lamp will be the best not because it is more economical but because

Its impracticable to work in series and all lamps given to consumers must be in multiple arc hence at a mile distant 1 one ohm lamp would require a conductor having a resistance not over 0.2 of an ohm whereas a 10000 lamp might have a conductor of .1 10 50 or even 100 ohms without materially weaken the ~~Ee~~ incandescence.



$$\begin{array}{r} 250 \\ 5 \\ \hline 1250 \end{array}$$

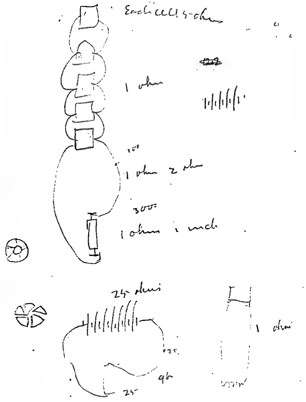
$$\begin{array}{r} 100 \\ 40 \\ \hline 4000 \end{array}$$

2. 1000

100

$$\begin{array}{r} 65 \\ 3 \\ \hline 195,000 \end{array}$$

1	1000	1	30000	2048	14 1/2
2	500	2	15000	4090	7 1/4
4	250	4	7500	8192	3 5/8
8	125	8	3750	16 400	1 13/16
16	62 1/2	16	1875	32 800	7/8
32	31 1/4	32	935	65 600	7/16
64	15 5/8	64	467		
128	7 3/4	128	233 1/2		
256.	3 7/8.	256	115 1/2		
		512	57 1/2		
		1024	29		

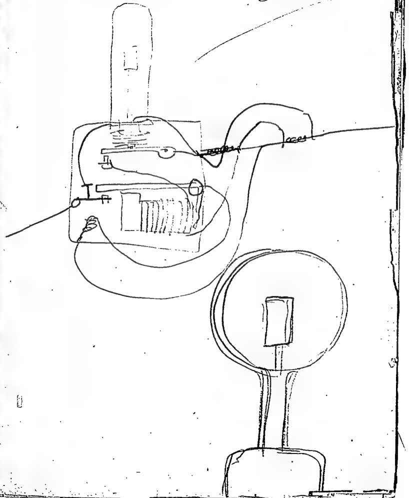


512.
1024

1.95
.95

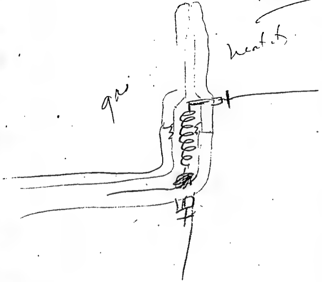
1	1000	
2	500	
4	250	
8	125	
	62	$.50
16	31	.25
32	15	.62
64	7	.81
128		
256	3	.90

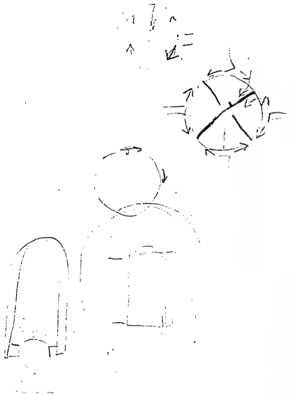
Dec 15 1878
T A Edison

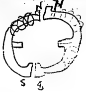


Dec 15 1878

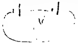
T A Edison

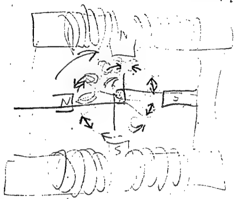


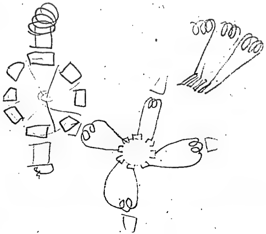




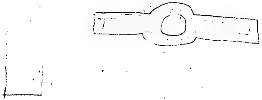
Dec 15, 78
Tai

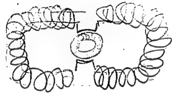


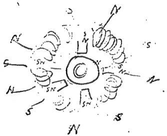


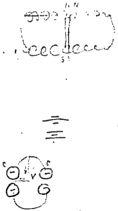


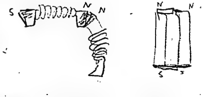
Dec 15-78
TAE





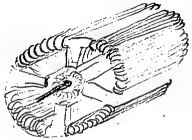




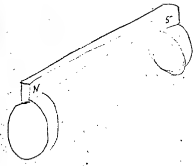


Dec 15 1878
TAE

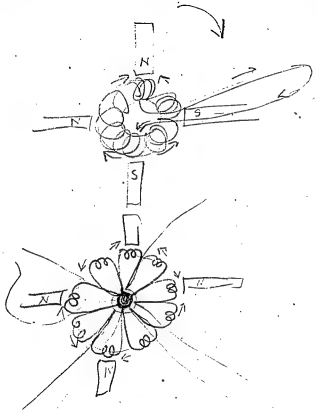
New magneto.



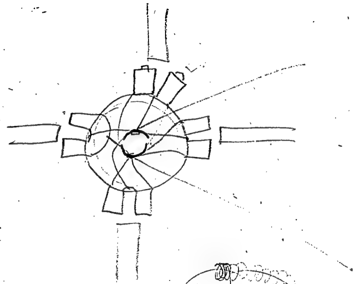
Dec 13 - 78
Gas

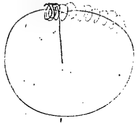


Dec 15 78
T. A. E

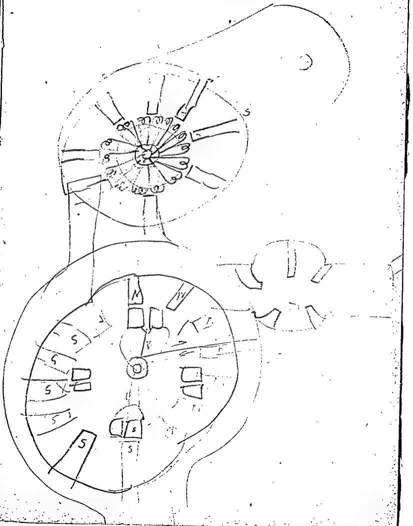


Dec 15-78
9 a.m.



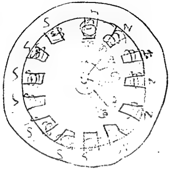


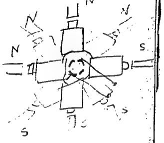
Dec 15–78
TAE

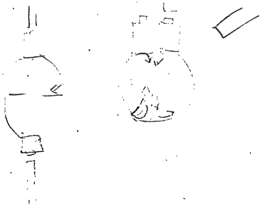


Dec 15-78

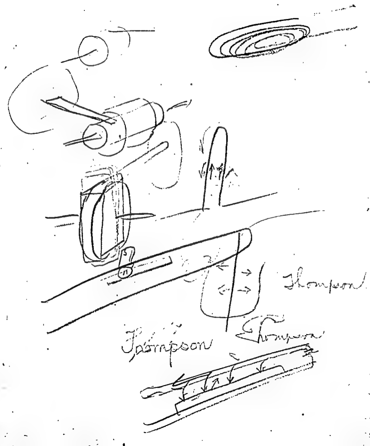
TAE

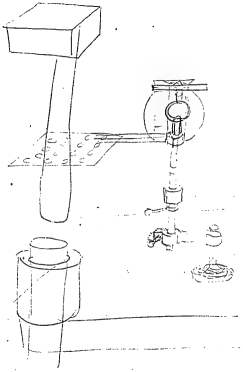


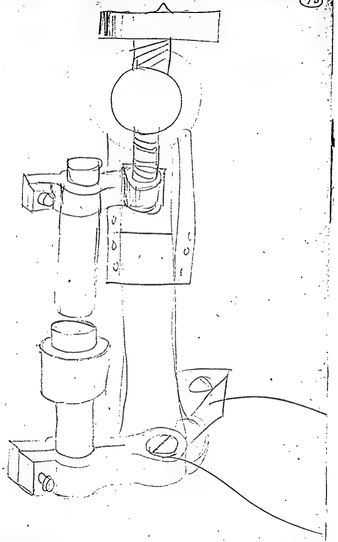


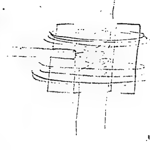


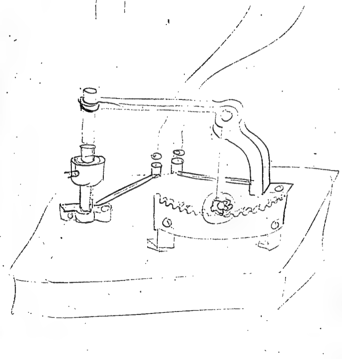
Dec 15 / 78
T.A.E.

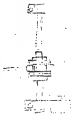


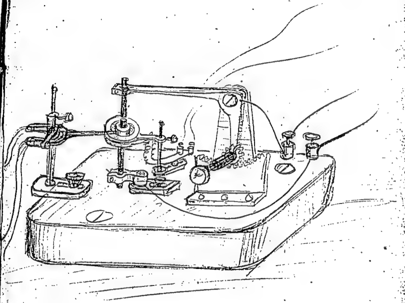












60 of chromium & 40 iron not attacked by Aqua Regia - white & cuts glass -

Platinum found in France -
Germany -

Platinum is sometimes alone, sometimes alloyed with the platinoid metals Palladium Rhodium, Osmium - & Iridium Ruthenium, and also is associated with Gold Silver Iron Manganese Copper Lead Sulphur Iron, Chromic Iron.

Glass

when transparent glass is maintained for some time at a high heat, but below fusion, it becomes opaque [illegible] fibrous in structure, a [illegible] conductor of heat & electricity [illegible] it's so much harder that it scratches glass. will bear sudden changes of temperature

like porcelain, it is commonly called devitrified glass or Reaumur's porcelain, but its proper name should be crystalline glass. This change is most readily effected with bottle or window glass.

Menlo Park Notebook #197 [N-82-06-08]

This notebook covers the period June-August 1882. Most of the entries are by Edison. There are also a few entries by Charles Batchelor. At the beginning of the book are notes by Batchelor on a record-keeping system for electric light companies. The remainder of the book contains notes and drawings by Edison, many of them for a draft caveat concerning lamps, generators, arc lights, and methods for regulating the electromotive force of the current. The label on the front cover is marked "Book Keeping for Electric Light." The book contains 280 numbered pages.

Blank pages not filmed: 122-123, 140-145, 156-197, 216-265, 272-273, 276-279.

Carbons for Elec Arc.
arc Lamps.
field Regltn.
Secy Battns.
Reciprocating Dynamos
Covering wire with Lead
with iron pipe —
Zinc pipe

A system for Keeping the Histories and Accounts of Electric Lighting Companies with the necessary forms for such Companies

Superintendents Department

Relating to the manufacture and distribution

First the Superintendent should have a plan of the central Station with the location of every ~~[illegible]~~ boiler, [illegible] steam connection, pumps, heaters also every Electrical Connection and position of the mains as they leave the ~~central stat~~ building.

he should also have a
plan of all main wires and
connection boxes etc

These plans should be kept
in a frame and should be
easy to remove to make any
necessary alterations —

Reading of water meter
Ashes thrown out.

Book 1

Boiler Room account

Date	Coal Received	No of hours running for each Boiler									
		1	2	3	4	5	6	7	8	9	10

This to be kept by the Boiler room attendant

Book 2

Engine Room Account

Date — Pressure Steam

No of hours for each engine Put on / taken off 1 2 3 4 5 6

Total Consumption

~~Consumption Not Chargeable~~

Date		No of hours for each Engine										Steam Pressure	Total Consump
		1	2	3	4	5	6	7	8	9	10		
	Put on / taken off												

~~Superintendent~~

2 Engineers Central
2 Helpers Station
2 Regulators
2 Firemen
4 Laborers 1 Wiper
Lamp boy

Chief Engineer is supposed to have full charge of everything & to be able to attend to accidents in case of necessity

---

Executive Office
has charge of
New houses (putting in)
Making renewals
Putting new plant
repairs
Supplies
and executive duties
paying wages.

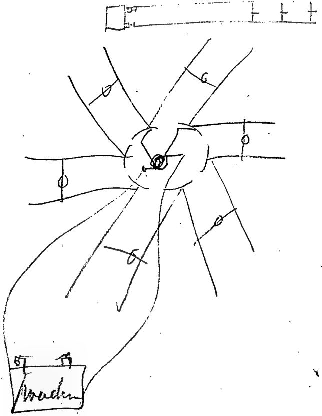
The Street Lamps will
be of given candle power
and be charged for the length of time
they burn

The Street Lamps will be taken direct from the main -

June 8 1882.

Reducing EMF -

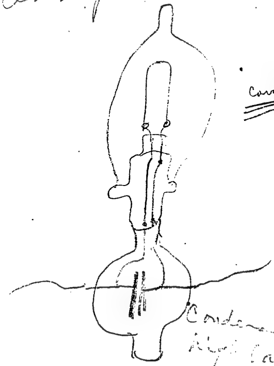
TAE



June 8 1882 TA [illegible]

June 8 1882 TAE

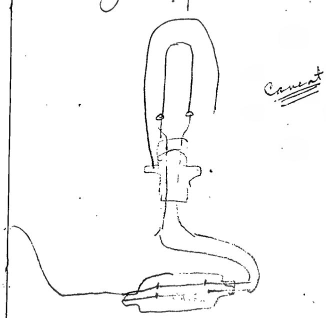
Peculiar Carrying in Lamp



June 8 1882 TAE

Prevention Electrical

Company



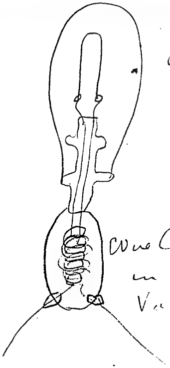
heated Conductor

Expmt Elec Carrying

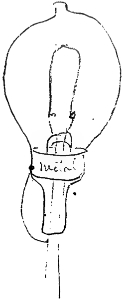
Jan 8 1882

TAE

Caveat

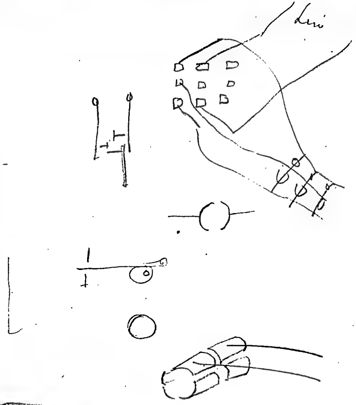


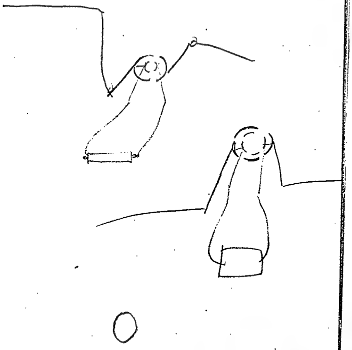
Expts Electrical Carrying

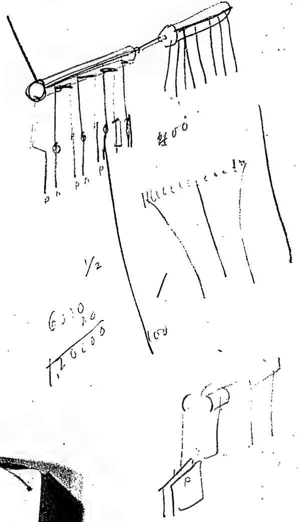


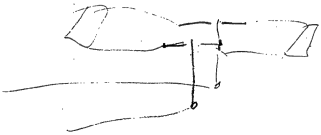
Jan 8 1882
TAE

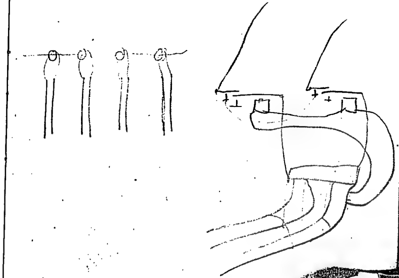
Caveat


Leni





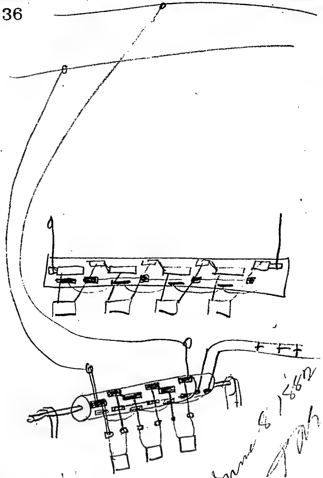




June 8 1882 TAE

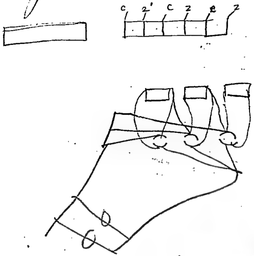
I propose to use 200 double plate cells of lead only exceedingly close together probably like a dry pile with moistened wool ~~betimes~~ with SO_3 - and charge these batteries across multiple arc in series & discharge in multiple arc (ie) 400 volts would give 50 or 50 volts a clutch on battery & touches main line for an ~~instant~~ & changes on common commutator (ie) separation throws it in quantity) the next instant & simultaneously throws lamps on this is done several times a second, 1 apparatus is put in each house with meter which acts to disconnect all

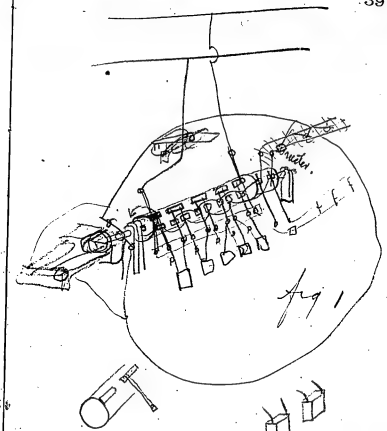
there is sufficient charge
but the instant it falls
below a definite amount
the rapid chgg & dischg
mechanism works; this
can also be done by a
centered armature & mag
across the Camp ckt



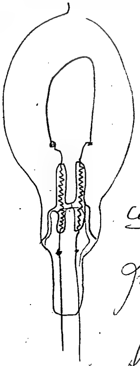
June 8 1882
TAE

June 8 1882 T.A.E.





June 8 1882
TAE

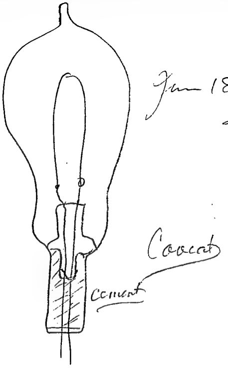


Caveat

June 18 1882

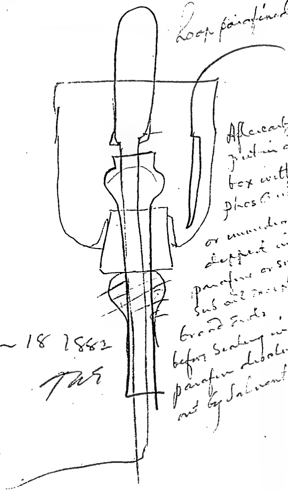
TAE

fig 1 Caveat



Jan 18 1882

TAG



Loop parafined

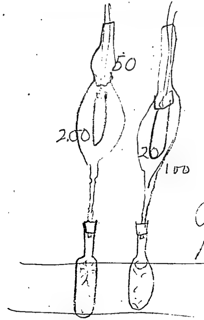
After carbonizing put in drying box with phos anhydride or immediately dipped in paraffine or similar sub all except ground ends before sealing in paraffine dissolved out by solvents

Jun 18 1882

TAE

57.

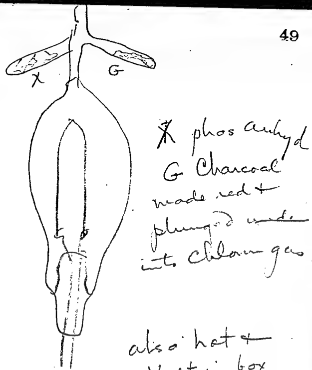
1



2000.

Jun 18 1882

after sealing [illegible] drying.
to be kept with the phial
ambry tube [illegible]

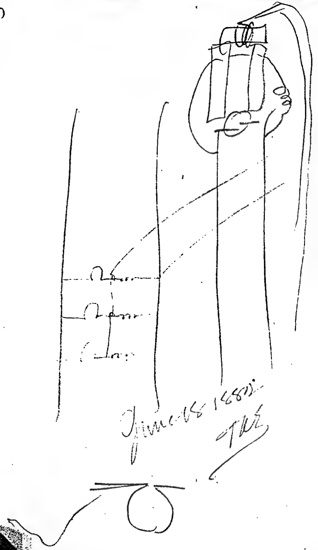


X phos anhyd
G Charcoal
made red +
plunged ~~under~~
into Chlorine gas -

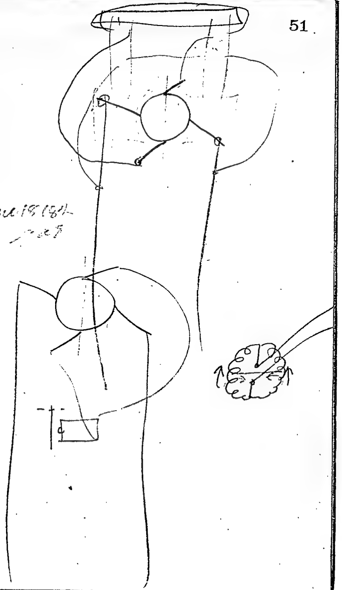
also hot +
Kept in box
with phos anh
until put in
lamp -

June 18 1882
TAE

also charcoal red
hot + put into
melted Chl Carbon



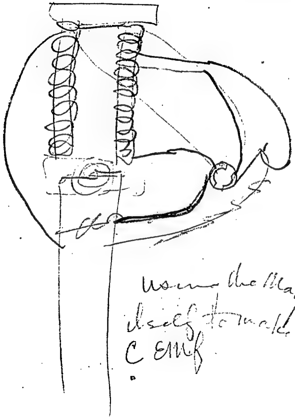
June 18 1882
TAE



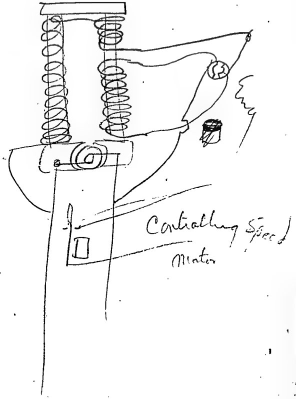
June 18 1882

June 18 1882

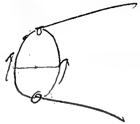
TAE

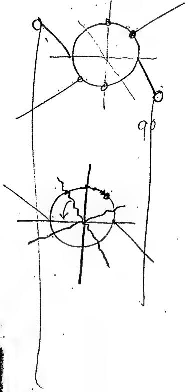


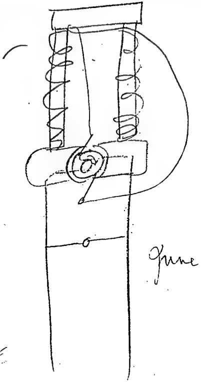
using the Mag
itself to make
C EMF



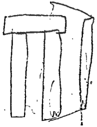
Controlling Speed
Motor

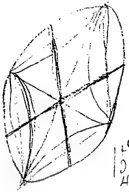






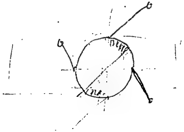
June 1882
TAE

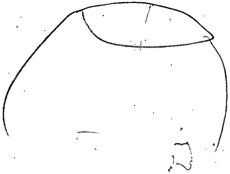




15000

15000000





400
400
160000
44
640000
640000
1000) 7040

25000
44
100000
100000
1000) 1100

25. 10

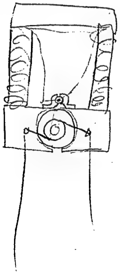
300
44 300
00000
1000) 396

60

100000
50000
25000
12

280
560
1000

280
3
840. 24.



June 18 1882.
T A Edison

June 18 1879 —

Carried

Paper [illegible]

[illegible]

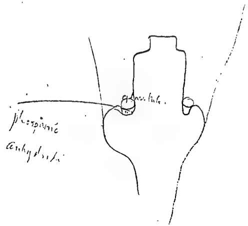
[illegible] phos

anhydride [illegible]

put in Lamp to

absorb the vapor

water TAE



[illegible]

[illegible]

Frang

François [illegible]

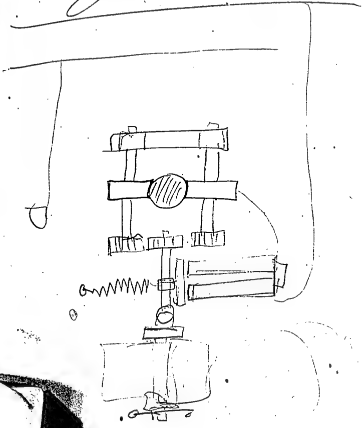
Françoise Françavani

W Wabash

Count

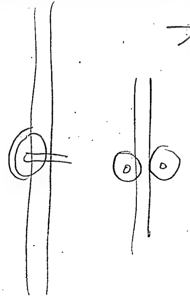
Use the fibre of the agave americana for lamps scraping off the outside [illegible]

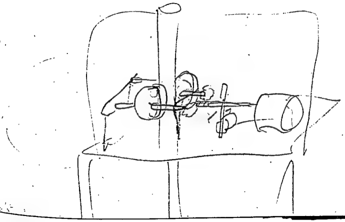
June 18, 1882
TAE



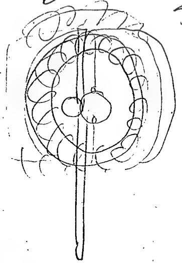
June 18 1882

TAE

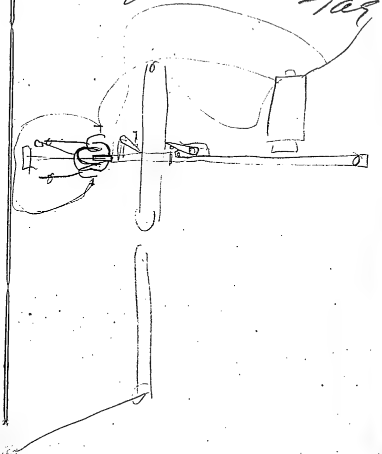


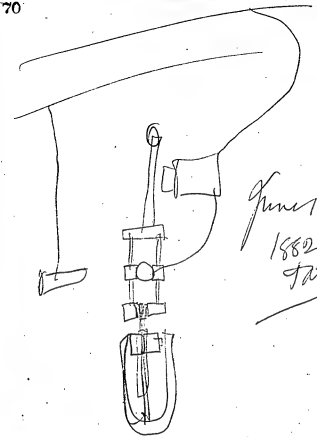


June 18 1882
TAE



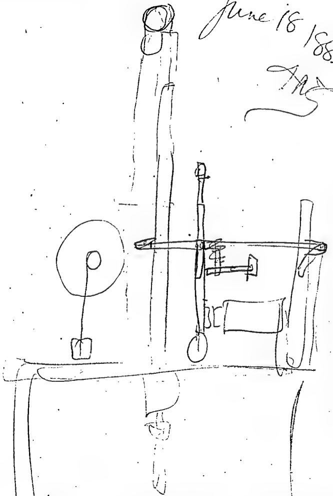
June 18 1882
TAE

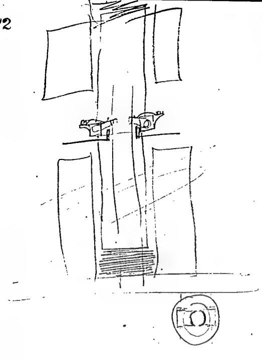


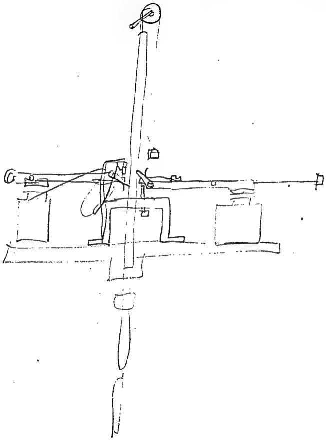


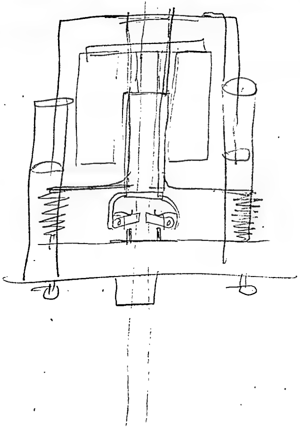
June 18
1882
TAE

June 18 1882
TAE









Caveat.

The object of this Caveat is to set forth various devices and inventions which I have perfected for use in my system of Electric Lighting, but which requires the invention and arrangement for economical manufacture etc that they may be used commercially

= In Electric Lamps when very high candle power and delicate filaments are used the sealing in of the wire through the lamp should be very perfect I use a platina leading in wire wound in the form of a spiral and both of the wires are sealed in tubes before final sealing to the inside part. See fig 1.

Straight Platina wires coated with Tin Lead or other soft metal may be used. Even platina

may be dispensed with and
Nickel iron Copper ~~and~~ Silver
Cobalt Steel & other wires
may be coated with tin lead
or other soft metal & sealed
in the glass, the Expansion &
Contraction of the glass being
allowable as ~~the~~ soft metal
gives, In the case of platinum
lead ~~gives~~ Combines with both
the glass and the platina
& therefore makes a good seal.
The platinum may be coated
with an oxide of lead mixed with
anhydrous Oxide of sodium
and fused in the glass the
lead attacks the platina &
the lead oxide soda & glass
Combines at the high
temperature to form glass

thus making a perfect seal
other metals as heretofore
mentioned may be used instead
of platina.
finely divided platinum may be
mixed with glass to such an
extent as to cause the glass-
platinum mixture to become
of sufficient conductivity
to be used as leading in wires
in this case there is a very
perfect seal - when platina
alone or platinum-Iridium
alloy is used for the leading
in wires I prefer to put it
through my process for
freeing it of air patented
in 1879 — I have made
lamps in which in addition
to the glass seal a cement

was poured into the inside part ~~that~~ was in vacua ~~this~~ Cement is preferably a cement having no pores with vitrous ~~fracture~~, Sealing wax & high boiling points tars resins are useful.—

To keep water from being absorbed by the carbonized filaments of ~~a~~ carbonizable ~~m~~ I dip them when they are taken out of the mould in a solution containing a dissolved vol. de the menstrum having no water ~~parafine~~ dissolved in ~~Benzine~~ a hydrocarbon liquid will cause the Carbon when dipped to be

Covered with a skin of paraffine, Beeswax, resins, gums Tar etc may be used all but ~~the~~ broadened Ends are so dipped, ~~afterwards~~ the Carbons are connected to the leading in wires & plated to them Electrically as (?) ... then before the Carbons are sealed in the ~~inner~~ bulb of the Lamp the paraffine or other gum or substance is well dissolved out by immersing the loop in a solvent of the substance on the Carbon. The loop is then sealed in the globe

and the top of the bulb has
a long tube upon the End
on the End of this tube is a
piece of rubber tubing.
Small tubes closed at one
End are filled with a drying
agent such as Sulphuric or
Phosphoric anhydride -
~~Pentachloride of Phosphorus~~
Chloride Calcium ~~dehydrated Sulphate Copper~~ or other
drying agents. and this tube
is provided with a bevelled
mouth into which the rubber
of the tube on the lamp fits
The lamps are kept with these
drying tubes on until ready
for Exhaustion on the pump
when they are placed on a
revolving heater and heated

& then placed on the pumps
a very rapid way of driving out
~~the moisture is to heat the~~
~~lamp by the revolving heater~~
~~then~~ place ~~the~~ bulb in connection
~~with~~ an exhausting & forcing
pump the bulb remaining on
ice. and Exhausting the air
& then forcing fresh air into
the bulb which must pass
over a long ~~tube~~ filled with
phosphoric anhydride or other
drying agents. when the
moisture has been driven out
of ~~the lamp~~ it is placed on
the revolving heater and heated
very hot and then placed
on the pumps - In ~~a~~ two side
tubes Connected to the Exhaust
tube of the Electric Lamp

one tube may have a drying agent such as phosphoric anhydride while the other may have organic charcoal which has been made red hot & ~~then~~ allowed to cool for an instant & plunged into dry chlorine gas, the charcoal absorbs chlorine ~~It~~ is then placed in the ~~tube~~, the bulb being previously dried as mentioned the lamp is exhausted. the charcoal tube sealed off at once or after a time while the phosphoric anhydride tube may remain on for a greater length of time

of course in Exhausting the Lamp the filament is at ~~time~~ being lit to incandescence

I will mention ~~that the~~ single tube might be used containing the drying agent & the chlorinated Charcoal and it might be sealed off the lamp or kept in permanent Connection ~~therewith~~ =

a Small ball of charcoal filled with phosphorus anhydride or other drying agent might be used ~~within~~ the Lamp.

the charcoal being impregnated with Chlorine, pure anhydrous Alumina. Silica in a finely divided State & pressed up into hollow Cubes balls or other shapes might ~~have~~ be filled with a drying

agent. Even paper & many other organic fibres ~~or~~ act as powerful drying agents & might be used.

A good method of regulating the Electromotive force of the Lamp Circuit automatically from the Dynamo or rather Magneto Electric machine, is to use seperate brushes on the Commutator to work the field and so place these brushes that when the load increases by putting in Lamps. ~~advantage~~ advantage will be taken of the shifting of the neutral point on the Commutator due to load to give a greater Electromotive force across these two brushes employed to give the field

magnet as Current, when the ~~two~~ brushes are placed at right angles to the brushes that from the lamp circuit. ~~it acts ...~~ the field from the bridge wire of a cohe~~ato one~~ balance ~~to ab~~ ~~this~~ is when the load is very light hence to obtain sufficient E.m.f. ~~to~~ energize the few lamps ~~that~~ are on the brushes must be set off of the exact neutral point, now if the load is increased by adding lamps the neutral point will shift & while this causes the Em.f of the

mainline brushes to drop the Emf between ~~in~~ the field brushes increases hence the drop in Emf on one is nearly compensated ~~by the~~ rise in the other due to ~~the action of the field magnet~~

Another method of regulating is to use a small Electric Engine for rotating brushes around a Commutator & have this Commutator Connected to a portion only of the coil around the field magnet this portion being more or less rapidly reversed by the rapidly revolving brushes the Engine being controlled by a magnet ~~or them~~ across

multiple arc or by a thermostat playing between ~~two~~ points. another device for regulating the Emf of a ~~D~~ Dynamic machine consists in interpolating in the line a Resistance in the form of several small wire multipled or a sheet, and winding this around a cylinder of mercury with a long tube Extending therefrom into which there a several platinum wires connected to resistance coils in the field of force magnets the rise & fall of the mercury column serving to Cut in & ~~shut~~ more or less resistance as more or less lamps are put on

~~this~~ mercury controller might be surrounded with very fine wire & the wire placed in multiple arc or it might receive its heat from an Electric Lamp radiating upon it such lamp being placed in multiple ~~arc~~ across the line,

an other ~~method~~ method of regulating the Lamp circuit consists in using an Extension from the polar field ~~cores & between~~ which Extension a small induction bobbin is rotated by a belt from the dynamo the belt is shifted by an Electric magnet

so it will either go slow or fast the electromagnet being either in or across the line, thermostatic devices may also control it = this latter bobbin is connected to the field of force coils + serves to energize them.

another form of device consists of the driving pulley either on the machine or from a countershaft or even the engine being loose on the shaft and is connected to the shaft through the intermediary of a spring + lever which lever serves to throw resistance in

and out of the ~~main~~ field of ~~the~~ magnets. If but ~~but~~ few lamps are on the circuit the drag on the pulley is light the spring is scarcely depressed and all the resistance is in. if now the load is increased. the spring will be depressed and ~~more~~ resistance will be cut out of circuit

another device consists in making a small portion of the curved polar extension of the field magnet detached & moveable, have means about 1/2 inch wide & 1/2 thick from part of the polar piece

and are connected together at the neutral point opening by brass, a lever is connected to the brass, ~~---~~ which leaves moving in the ~~direction~~ of ~~rotation~~ of the dynamo. bobbin cuts out resistance the ~~tendency~~ of the field or any part of it which is moveable is to move in the same direction as the rotating armature and this tendency increases with the load ~~Hence~~: this ring encircling the rotating bobbin tends to rotate with the bobbin in proportion to the load hence it becomes a very accurate device in connection

with resistance to regulate
the lamp by the field
magnet.

If plates of zinc with lead
between which are placed
insulating material such as
porous plates, and several
pairs of ~~these~~ placed in a
cell half of the plates
being connected to one
pole & the other half to the
other pole. and ~~the~~ whole
of the plates kept pressed
together by a wedge
Spring. gravitation or otherwise

and a 20 percent solution of sulphuric acid be used and ~~the~~ liquid kept nearly to the boiling point & the battery while thus hot is connected to a powerful dynamo machine, thick coats of peroxide of lead are formed rapidly all homogeneous & integral & in Electrical Contact with ~~the~~ Electrode this Coating ~~whence~~ when once formed remains integral the great object in perfect Storage batteries always charging & discharging the Elements while they

are under pressure the more porous all the pressure is the better.

In forming Carbons for Electric Light arcs I use non volatile hydrocarbons such as the thickened Rubber like substance obtained from boiling the drying oil. the Carbon finely powdered is mixed with the viscous drying oil Either with or with asphaltum and well ground it is then dried and then put in a powerful press & forced out into sticks. they are then baked & brought up to

a white heat then when
cool are placed in tubes
with a volatile hydrocarbon
or bitumen coil, the tube
is closed and the whole
brought up to a white
heat the gases formed
enter into the pores of the
carbon & deposit dense
carbon therein due to the
enormous high pressure in the
tube due to the gases (chlorides
chlorides of carbon may be used)
The tubes may be made so
strong that a liquid
hydrocarbons may be used)
and be brought to a white

heat, Extremely dense Carbons are thus obtained which do not oxidize just above the are like ordinary Carbons hence will last ten or 15 times longer than ordinary Carbons besides they are better Conductors of Electricity.

When several filaments are placed in series in one Lamp sometimes one of the filaments has a higher resistance than the others in this Case a side tube being placed on the Exhausting tube & containing chloride of Carbon the particular filament is brought up to incandescence for an instant to reduce its resistance by a

300 300
900000
556000
482

325
325
1625
650
975 23
1056 40
4225 00
11225 0 . 800) 4 647 5
5800
185
3
525

15000
6
90000

1600
3
4800

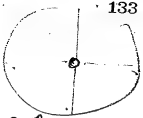
260
3
780.

800.

deposit of Carbon in it. it is
then compared with the other
& when all give the same
light with the same volts
they are permanently connected
in series and the Lamp
sealed off at the pump.
another method is to shunt
the particular lamp by a
[illegible] fibre filament & exterior
to the Lamp but of a very
high resistance & through
which current passes. it the
insufficient to bring it to
the oxidizing point this
resistance may be placed
in the base of the Lamp

12   1200
10

12000
3
36.000
300
10800000
16
64800000
10800000
172800
2000) 86400



8.000 000

10 000 000
33
30000000
30000000
330,000,000

330000
2

$750,000

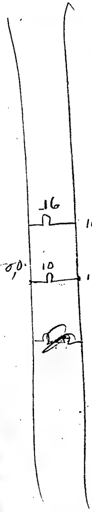
330.000 Ms.

86.400 Ms.   90.

60 - 16

1.12 - 10

85



10 —— 12

103 +40 —— 320

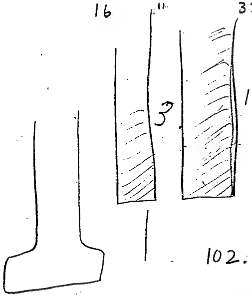
60.

80.

16, Candles. 140. ohms

90,000.

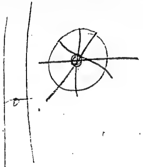
320. 40,000,



102. 1.20

16 -

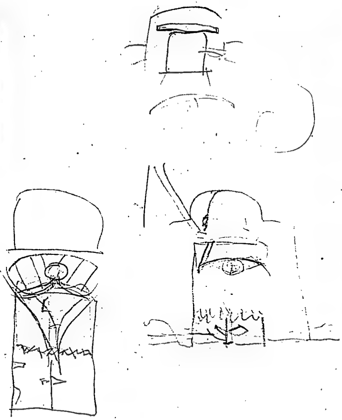
3

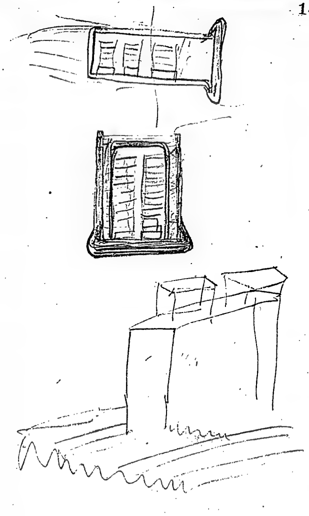


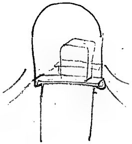
9

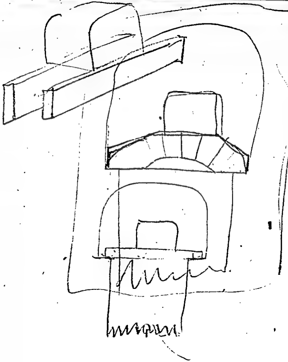
18

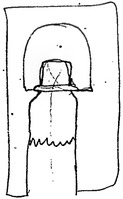
10. 320.

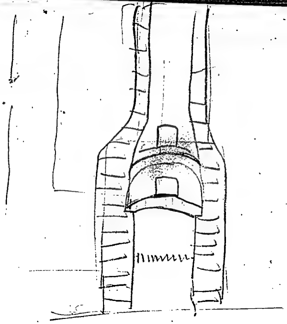


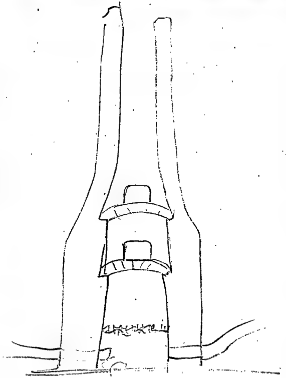


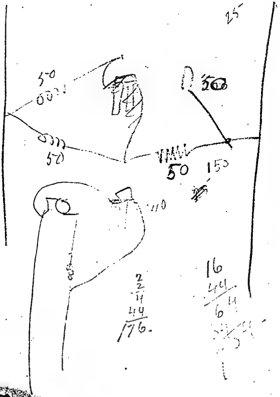








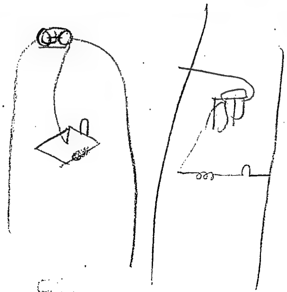


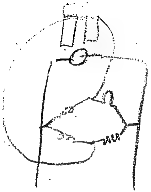


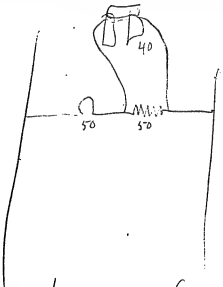
175.

175.

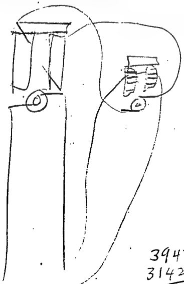
176.







180) 551930 (3
540
119.



3942
3142
800.

10
140) 440000 (3142
420
200
140
600
560
400
280

112
112
224
112
112
12544
44
50176
50176 (3942
140) 55193
420
1319
1260
593
560
33

175) 3153 (18
175
1403
1400
178

35
18
280
350
630

175) 551930 (3153
525
269
175
943
875
680
525

140) 3153 (22
280
353
280

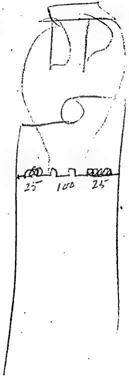
3150

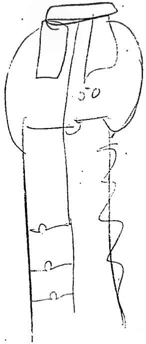
500 (35
60
140
110

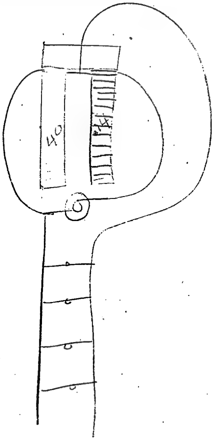
35
22
70
700
770

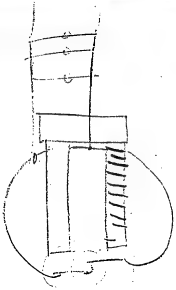
22
35
110
660
770

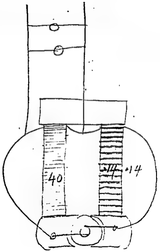
175) 3942 (22
350
442
350
92


25 100 25


50

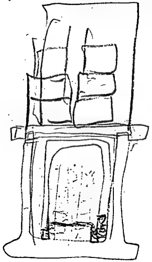

40

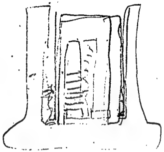


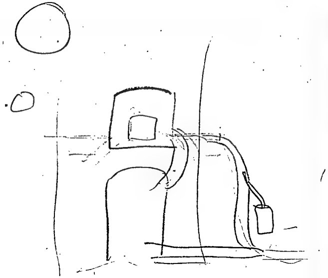


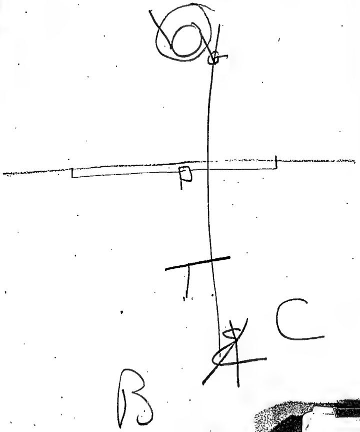
John Ott to try
and Roland to [illegible]
Aug 18 [illegible]
[illegible]

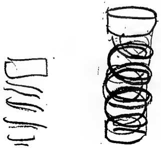
Deposit Carbon from pure CO or
CO_2 see if free O attacks
Carbon Aug 15 1882

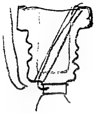


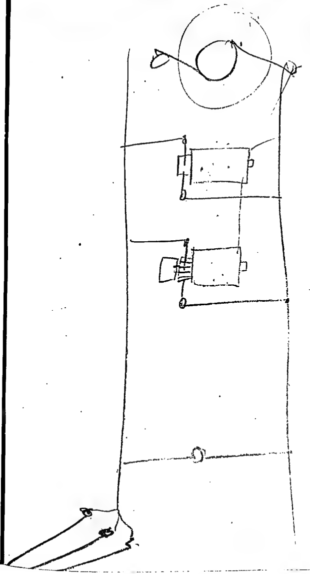


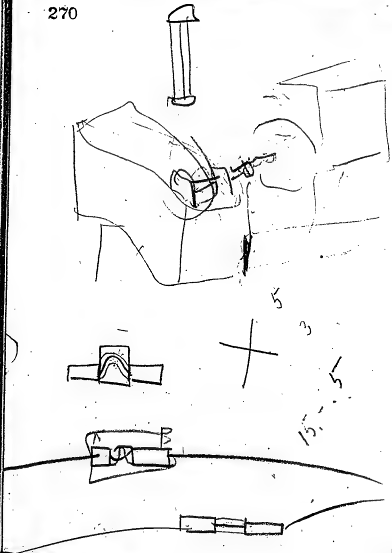


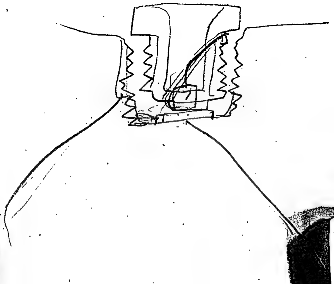

C
B





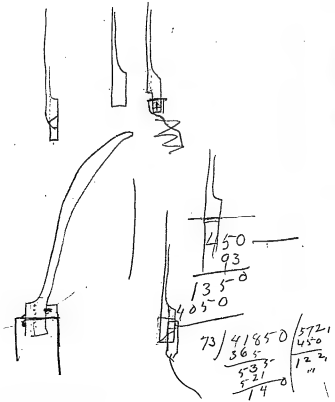



5
3
5
15



Mercury circle Motor.
Rubber expansion motor.
Photogh scintillations with Cardi both
which Leyden + Big Coil + with Condenser
+ battery or dynamo,

[ITEM FOUND IN BOOK]



35

125

75

40 / 5000

125
100
75

40 / 300 (7.5
280
200
2

75 / 1000 (16.
750
250
450

Menlo Park Notebook #198 [N-82-05-10]

This notebook covers the period May-June 1882. All of the entries are by Edison and consist of notes and drawings relating to iron ore separation, thermoelectricity experiments, the electric railroad, electric lighting, and storage batteries. The book contains 278 numbered pages.

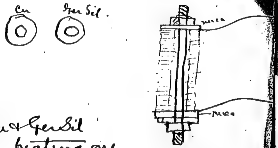
Blank pages not filmed: 26, 43-49, 76-77, 82-83, 86-101, 104-109, 112-153, 156-273.

Missing page numbers: 27-42.

May 10 1882.

Experimenting on reducing iron sand to iron also mixing with Coke, charcoal, etc & tar, Crude Pet, Mould in brix and heating sufficiently to consolidate,

Thermo Experiments



discs of Cu & GerSil alternated. heating one End causes heat travel to other end and there is a gradual fall of heat until the other End is scarcely hotter than the atmosphere.. by using several thousands of these discs an exceedingly novel & Economical conversion of heat into Elect is obtained

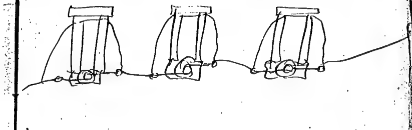
May 10 1882

I am plating Copper sheet with
German Silver also other
sheet of Copper with nickel.
~~alternately~~. first Copper then
Exceedingly thin Coat nickel then
Copper then nickel & so on
until several hundreds
thickness is obtained the
sheet is then Cut out in
Circles holes drilled ~~in~~
Centre & ~~all~~ several discs
bolted together forming
thermo pile,

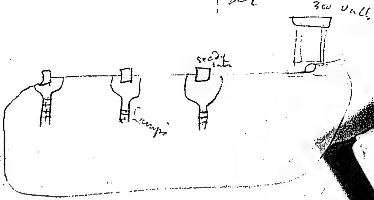
Today we run the Electric
Railway with 3 machines
in series each working its
own field independent
of the other as shown
on next page

May 10 1882 TAE

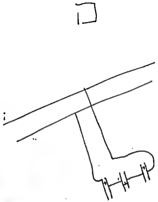
John F Ott



May 10 1882
TAE

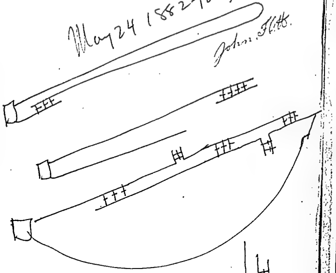


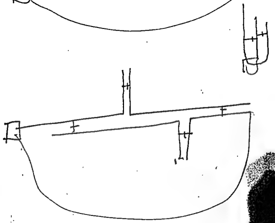
Reduce pressure by Secondy battery. no consumption



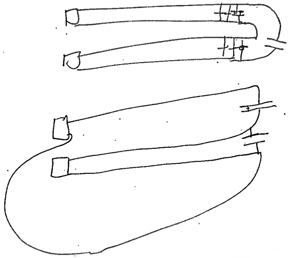
May 24 1882 Tas

John Flitt.





May 24 1882
TAE

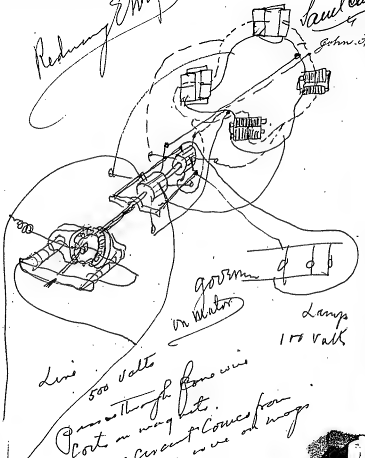


Reducing EMF May 24 1882

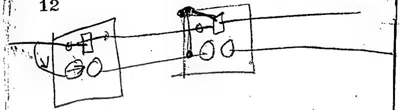
TAE

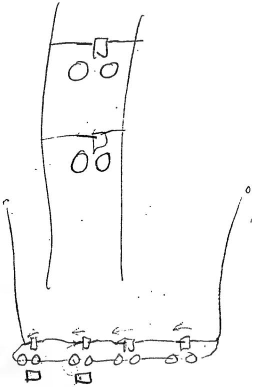
Saml Insull

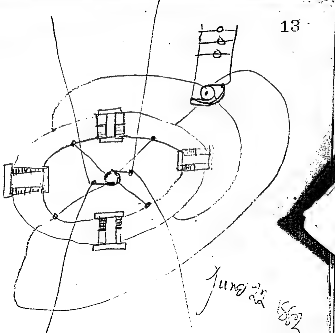
John F. Ott



Passes through fine wire
Cores in magnets.
Lamp circuit Comes from
Coarse wire on mags







June 29 1880

Reduction Cirt.

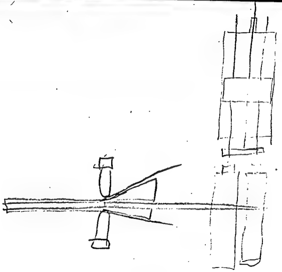
both pair branches
group in multiple and
together the main line
Coils are of fine wire &
500 to 1000 volts used
while the local Coils of
large wire & 100 volts used

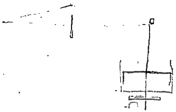
TAE
Chas. T. Hughes
John F. Ott

New Method preparing
Lead plates for storage
consists of facing a lead
plate with an alloy of
Lead & Zinc, Immerse
in SO_3 & put battery on
with paper between &
plates under pressure.
after preparation the
plates are taken out &
put in fresh cell with
$SO_3 + H_2O$. ready for use
in future —

June 22 1882

TAE
Chas. T. Hughes
John Ott





60.

600
90
54000
5
270,000

400.
30
12000.
15

40.

12000
3
36000
[illegible]

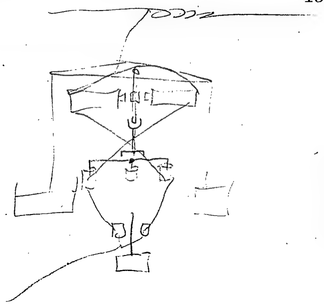
36000
30
1080000

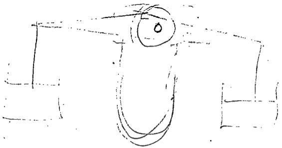
270.

3

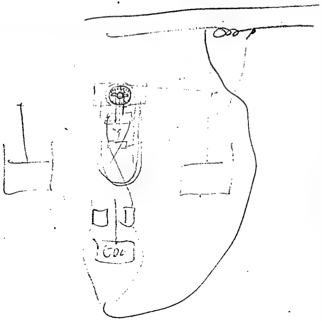
400.
32

640 | 100000 (15
6400
36000
32000





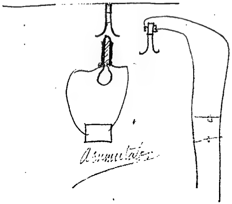
June 20 1882
John F. Ott. TAE



June 23 1882

TAE

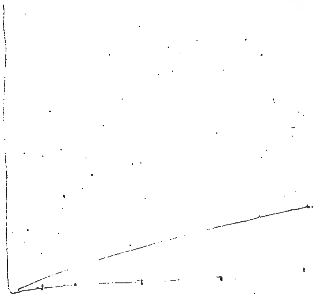
John F Ott

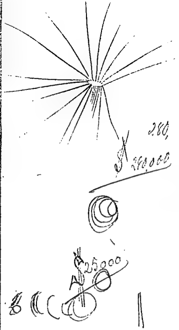


Dust and Company

Company

Directors Technic
Frazer Trembolme Co
Warrington
Pictures Warrington
Carroway
Frames





Fabbri —	2500
Wright	2500
Adams	2500
P Morgan —	2500
Eaton	1,000
EHJ.	3000
Batch	3000
Edison	5000
Bergmann	1000
Upton.	3000

5

50000

$$\begin{array}{r} 25 \\ 10 \\ \hline 250 \end{array} \quad 10$$

Warrington

~~Warrington~~

Warrington

Warrington Washington

Washington

Washington

England

Williamson

England Correspondencia

Williamson

Magi Williamson

Curriculo Mamphisto

Curriculo Circo Circulo

600 | 607 500
1012
600
607.200

1012
50

35
25
175
70
8 7 5

1012
650
605

225
3
675
3
2025 300
600 | 607.500 | 16

7
24 | 112 | 4.6
96
160

5

202500
3
607.500 | 1310

225
3
675 300
2025 00

365
250

825
255
730
100 3 7

40
5
200

50
5
250

10

5 | 225
45
4
100

350
40

~~250 Lights~~
225 (16 c.p.?) at max

1 Dynamo	1350
1 Extra armature	375
1 Engine	750
Piping	125
1 Boiler	875
1 Regulator	25
1 Indicator	25
1 Photometer	12
2 Belts	25
Station	500
foundations setting }	300
Installation	160
Meters $4	50
Scale	
Extra plates Solution Etc	20
Oil cans waste etc	10
Smoke Stack	30
poles. 150 poles	375
Setting	125
Stringing wire	200
Wire	
Insulators	90
Running 5 Houses wire Insulation etc.	150
Running Expenses	
Lamps.	500
Engineer	1000
Meter Bookkeeper collector man	800
Coal 3 hours daily 225 lights 400 lbs	300
5 Etc included Meter Supplies Extras etc Repair	250

5 miles poles

~~500 group~~ Lights
only 450 used at maximum

2 dynamos	2700
1 Extra armature	375
2 Engines	1500
Piping	175
1 Boiler	1600
1 Regulator	25
1 Indicator	25
1 Photometer	10
3 [illegible]	37
Station	500
Foundations setting	450
Installing	~~[illegible]~~ 50
Smoke Stack	~~225~~ 320
Meters	50
Scale	25
Extra plates [illegible] etc	10
Oil Cans waste etc	

Poles - setting stringing
wire -
Wire.
Insulators
Running to Houses

Running Ex

Lamps	1000
Engr	1000
Boy	300
Outside man Meter etc	900
800 lbs Coal per night	500
Oil waste supplies Repairs	500

149.

16 320

675
5
3375

5/675
135
20
2700

3

~~750 lights~~
675 used at maximum

3 Dynamos	4050
1 Extra armature	375
3 Engines	2250
1 Boiler	2700
~~Piping~~	200
Regulators	60
	50
4 Belts	500
Station	600
foundations setting Install	75
Etc	~~325~~ 500
Meters	85
Scale - Extra platinum etc	15
oil Cans waste Etc	

Poles. setting. stringing wire
Wire.
Insulators
Running wire to houses

Lamps	1500
Engr	1000
Extra man.	450
Outside man Meters books etc	1000
1200 lbs coal - 3 hours run	900
oil waste Repairs supplies!	750

13050

75
900
200 | 67500
33700

65
300
33 | 19500
6400
13350

~~1000~~ Lights –
900 Maximum

4 Dynamos	5400
extra armature	375
4 Engines.	3000
1 Boiler.	3000
Piping	250
Regulation	75
6 Belts.	500
~~Station~~	800
Foundations Setting Installing	100
~~Strucle~~	800
Meters	125
Scale extra plates Etc	25
Oil Cans Etc	

Poles setting stringing wire
Wire
Insulators
Running to house

Lamps.	2000
Engr	1000
Extra man	450
General man	1000
Coal.	1250
Repairs Supplies	1000

200
15
00

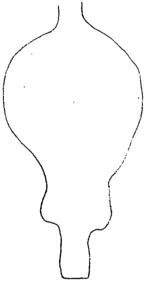
1500
2
3000

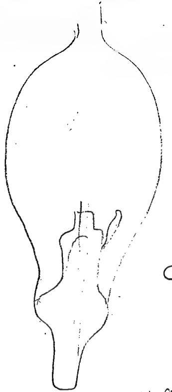
1250
1125 maximum

5 Dynamos	6750
2 extra armatures	750
2 Large Engines	2400
1 Small do	750
1 Boiler	3500
Piping	360
Regulation	150
7 belts	650
Station	1200
Foundation setting & Installing	150
[illegible]	1000
Meters	160
Scale extra pieces Etc	35
oil cans	

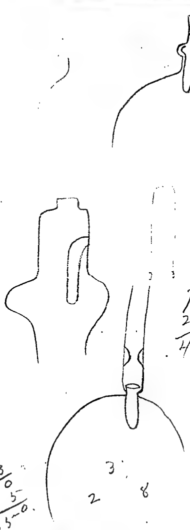
Poles setting stringing wire
Wire
Insulation
Running wires to houses

Lamps	2500
Engineer	1200
	500
Extra man fire	1300
Insulation & Supp.	1600
Coal	1300
Repairs & supplies	





11980
274
12254



45
6
270
135
1350
2700
4050

310
3
930
5
4650

~~1500 Light~~
1350 Maxim.

Extra pillow blocks.	100
1 Extra switch	50
6 dynamos	8100
2 Extra armature	750
3 Large Engines	3600
piping	350
1 Boiler	4200
Regltr	125
8 Belts.	225
Station	800
Foundations Setting Etc	1600
	200
Shade	1300
Meters	200
Scale Extra plates etc.	50
Oil Cans etc	

Poles Setting Stringing wire.
Insulators
Running to Houses

[illegible]	3000
Engineer	1300
Extra man	525
General man & Sup.	1450
Coal.	2100
Repairs Supplies Etc	1700

90
60
450
15
2250
450
675

45
7
315
15
1575
315
472

~~1750 Lights~~
1575 maximum –

7 Dynamos	9450
2 Extra armature	750
Extra pillow blocks & switches —	250
3 Large 1 small Engine	4350
1 Boiler? piping —	4350
~~Regulation~~	~~200~~
	275
10 feeders —	1000
Station	1900
Foundation setting —	275
Sundries —	1600
Meters —	300
6 scale plates 50 ea.	

Lamps	3500
Engr	1300
asst Engr	750
Fireman —	575
General man & boy	1500
	500
~~Wireman~~ outside man	250
Coal	2300
Repairs supplies etc	

2500
3
7500
3
22500 300
6)6750 / 1125

225
12
450
225
2700

1125

1350
12
2700
1350
16200

12
45
60
48
540
5400

12
300
3600

2000 Light
2000 maxim

10 Dynamos —	13500
2 exhaust [illegible]	750
5 Large Engines —	6000
Pipe [illegible]	2500
[illegible]	6750
2 Boilers —	850
Regulators —	350
12 Belts	1400
Station	
Foundation setting etc	2500
	350
Stax —	2000
Meters	400
Scales etc	
Lamps	4500
[illegible]	[illegible]
[illegible]	500
Fires and [illegible]	500
General [illegible]	1750
Contingencies	750
Coal	3400
Repairs + supplies	2500

3600
8100
150
200
12050

1350
6
8100

45
12
90
45
540
1
270
540
81

275
3
1125

57300

2500
95
12500
17500
1649
93

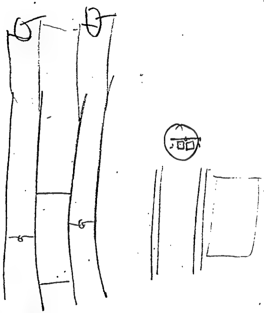
93
2
186
300
558
185
3700

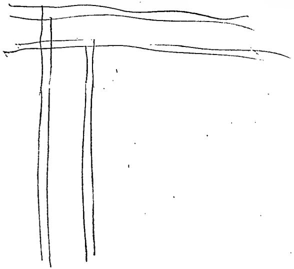
2500 Lights

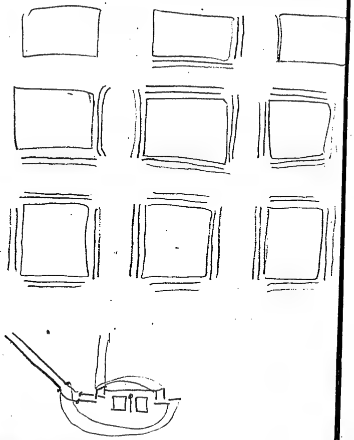
Switches extra armature 1100
125
12 dynamos 16200
pulleys etc. 300
6 Large Engines 7200
Extra Engine parts 300
Boilers 8500
piping 800
Regulation, chimneys 450
425
15 belts. 1700
Station 3200
foundation setting etc. 450
Stax 2500
Meters 525
Scales etc

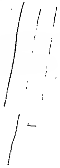
Lamps. 5700
Engr. 1400
900
Asst Engr 1000
Fireman 4 at. 1700
General workmen 800
Contrademan. 3800
Coal
Extras Repairs Supplies etc. 3200

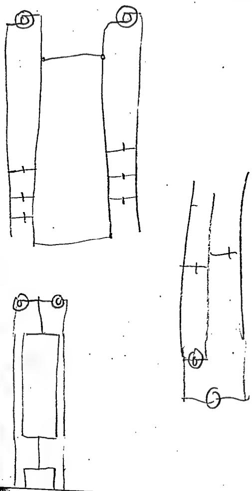
3000 Lights











65. 1

40. 2 1/2 1 1/7.

8.
1.25
.35
75
20
10.55

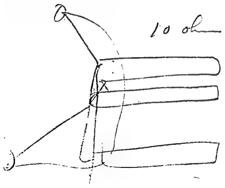
5250

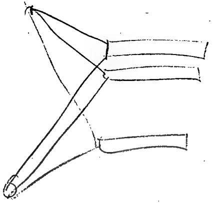
550
10

4.

5250
2640
1056

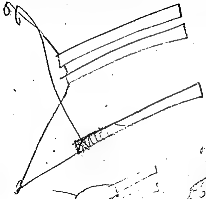
7500
5550.
1305
1056


10 ohm



17 | 1760000
220000
1760000
20.1760000 (103.5

17) 1760000
17
60
51
90
85
50
200
200
44
40000
4
176000
17
85000
8
704000
8
88000



17

704
480
56320
28160
33792
33000
792
7.7 (10

20

60
8
10 [illegible] 480.

5280
8
60) 42240 (704
420
240
240

704
60
42240

c "Chosen illuminative Souls of this world"

E = "Dieting his intellect"

60

50
100
5000.

8

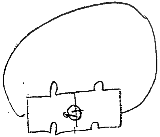
64

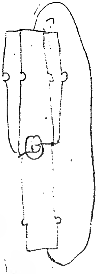
300
20
12 / 6000
6

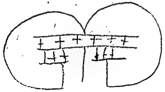
850
850
42500
6800
72250

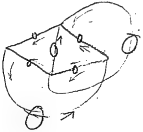
5000
500
33 / 2500000 (76
231
190
198

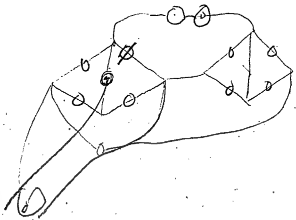
76.







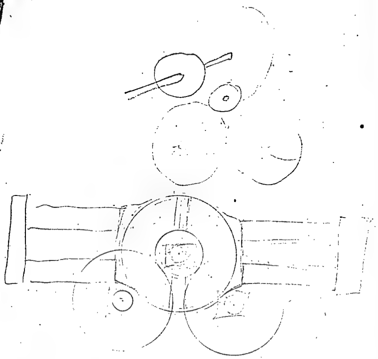


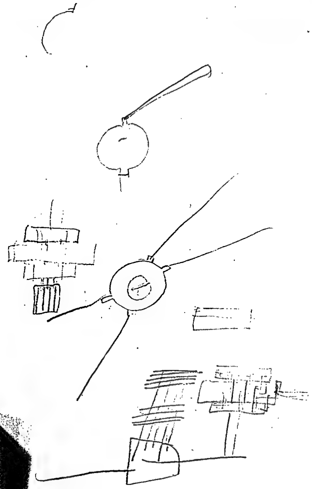


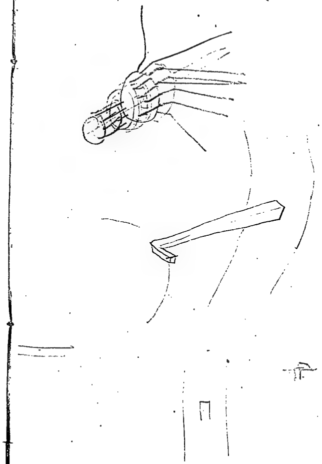
Menlo Park Notebook #201 [N-81-05-21]

This notebook covers the period May 1881. All of the entries are by Edison and consist of notes and drawings relating to dynamos and arc lights. The book contains 280 numbered pages.

Blank pages not filmed: 16-19, 26-29, 40-111, 114-280.







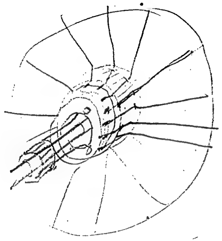
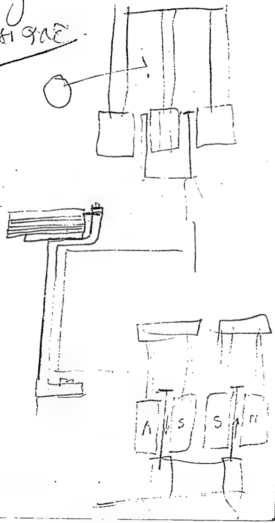
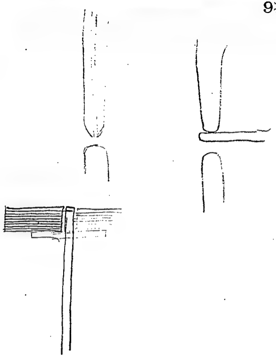
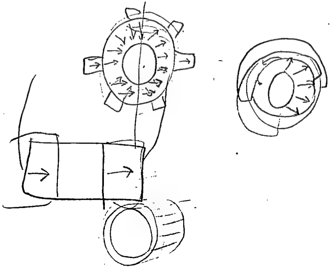


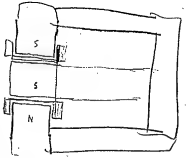
Plate Dynamo —

May 24 1881 TAE





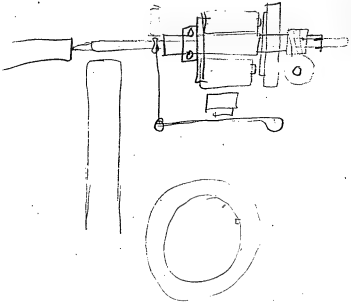


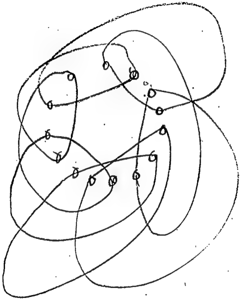


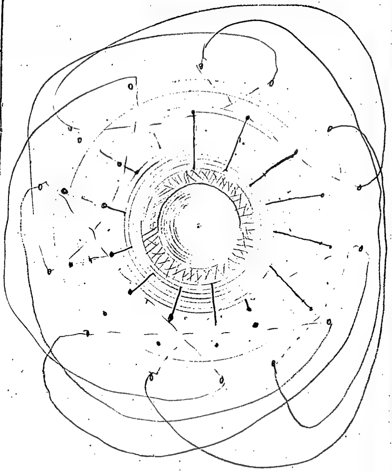
May 24 1881

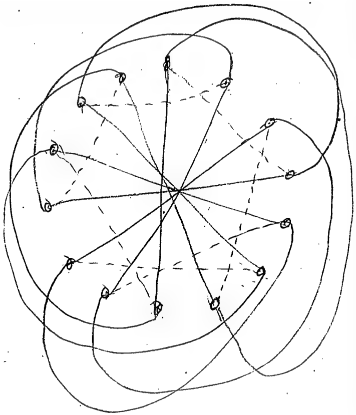
Arc Light =

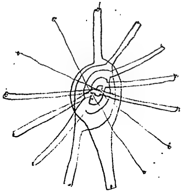
TAE

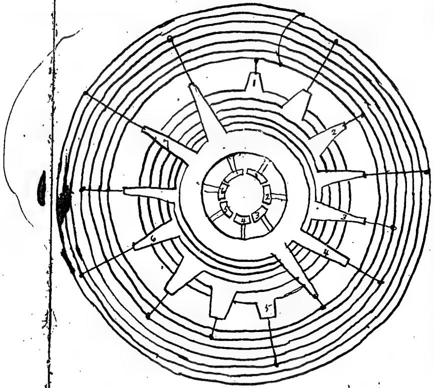




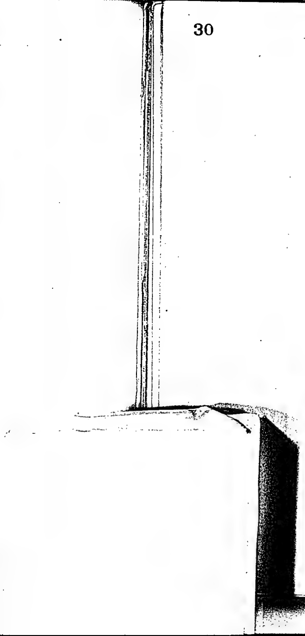


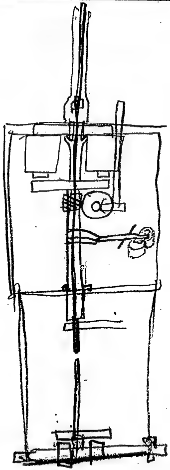


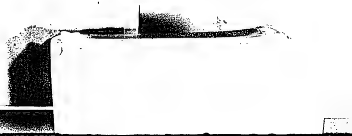


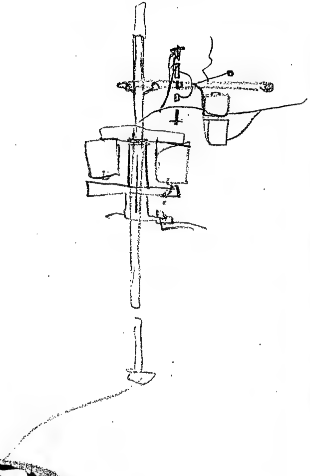


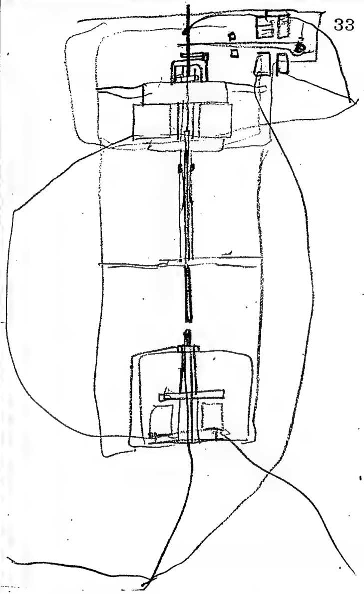
Matter for patent
Aug 21 1881
TAE

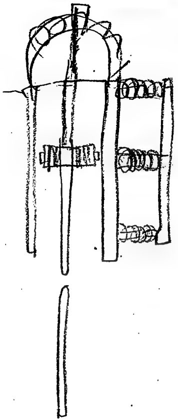


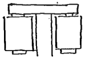


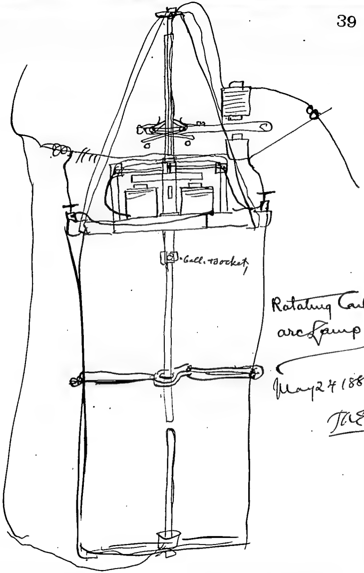








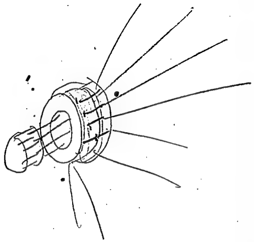




Rotating Carbon arc Lamp

May 24 1881

TAE



Menlo Park Notebook #203 [N-82-05-15]

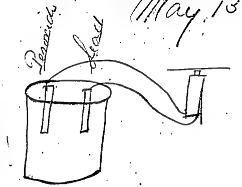
This notebook covers the periods May-December 1882 and July-October 1884. The entries are by Edison, Martin N. Force, and John Ott. Most of the entries are notes and drawings relating to storage battery experiments, including a set of notes by Edison on the direct production of electricity from carbon in batteries. There are also notes and drawings of filament experiments, notes on insulating commutator brushes with plaster of paris, notes and drawings of telephone experiments, and notes on an electric light plant in New York. The label on the front cover is marked "Menlo Park" and "M N F." The book contains 278 numbered pages.

Blank pages not filmed: 82-103, 136-137, 184-185, 218-271, 274-277.

X E-172 N-82-05-15

1

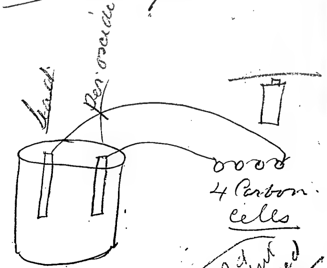
May 15 1882



Solution of
Ounce acetate
Lead in 6 oz
water

Tried this
experiment
Edison did not
state the results

May 15 1882



10 pct. Sul Acid
100 water
both plates
Per-oxide Lead

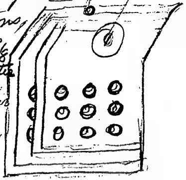
This worked very well but soon polarized

May. 16 1882

Took two lead plates perforated, ~~with~~ filled one plate, with finely divided ^metalic^ lead made in the chemical laboratory The other plate was filled with per-Oxide Lead, not pressed This worked well, without any charge being a battery in its self

May 17th 1882

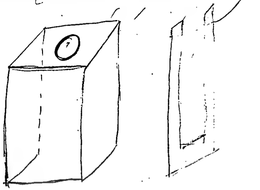
Took two Lead plates Perforated) filled one plate with per,oxide of lead pressed in buttons, about 3/8 in diameter

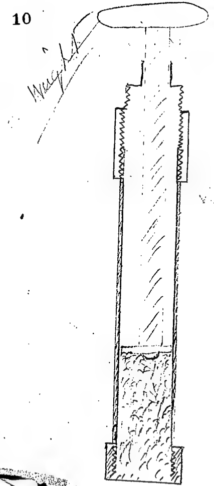


The other plate was filled

May 18 1882

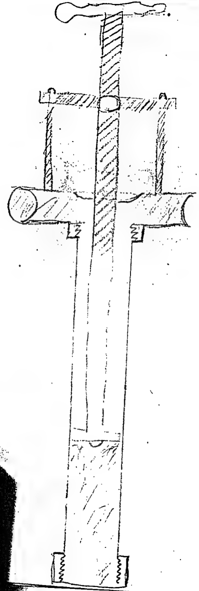
Made two moulds of charcoal for Mr Edison to try an experiment with, like this





May 19 1882

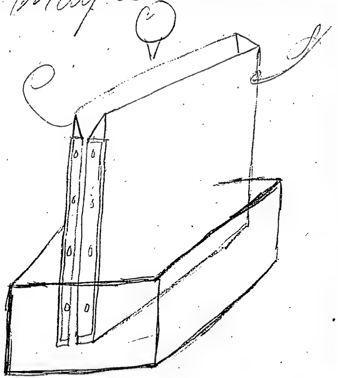
Tried an experiment
on Carbon Took some
Bituminous coal and
powdered it finely then
put it in a Tube made
of 1/4 inch iron pipe
made a plunger to fit
the inside of the pipe, and
then put in the furnace
with a heavy weight on
the plunger brought it
up to a light red,



May 20 1889

Tried [redacted]
experiment on carbon
but instead of putting the
preasure on by a weight
I done it by a screw
So I changed ~~to~~ it and
made it like the sketch

May 25 1882



May 30 1882 TAE

Experiments in crucibles
with fused substances &
different Electrodes

Fused Sulphate Lead
iron & Carbon Electrodes
40 deg deflection on Tang
gal. high resist Coil | &
20 Siemens units resis
outside —

deflt'ory

over

May 30 1882 TAE

def to right

fused phosphate Soda fuses
Easily - Iron & Carb Electrodes
40 deg in gal - Just works well
140 ohm relay -
addition Caustic Soda
makes no differen in
deflection - addition
peroxide manganese Solidifies
it & goes to Zero bad
mixture Manganese Conductor
Electrolytically - over

May 30 1882 9 a.m.

Sulphate Lead & Caustic
Soda, Iron + Carb with
Sul Lead alone requ
high temperature. (=careful)
gives 40 deg - addition
Caustic K gives 40
deg contrary direction

deg to right

[illegible]

May 30 1882 ofTAE

Nitrate Soda & Caustic Soda. Fe + C Electrode
35 deg deflectn to right downwards
W. H. Relay - hard to
melt couldnt melt
~~without~~ Caustic.
but spose if got temp.
high enuff it'd do it.
Exprmnt not satisfactory
Nit Soda appears gave off
something that burns

May 30 1882 T A E

Just tried ~~&~~ made some
Leafy lead by pouring molten
lead from heighth into water
this lead to be used
with or without lead
plates in Storage Battery

=

Caustic Potassa Reversal.
Potash Cause and Current
to left— Current to
left was — burning of
Carbon pole. I think
40 deg deflection constant
if maintained heat,

May 30 1882

Stern by dropping #.
lead 36 feet got it more
porous -- made a plate
of lead for Storage bat
which was disturbed [illegible]
as it got mushy -

making a sheet lead
which just a coating
is put full holes dep. of
brush To increase
contact.

May 31st 1882

Sulphate Potash, good gives 60 with 20 ohms to right — requires 400 Siemens Units to reduce it to 20 deg deflection = Ext Carbon strongly contsay of iron is corroded, requires high heat to act, Martin finds iron is attacked - but Ecimpeal solution so high may be atmospheric solution on bath iron & Fe — Relay works well. With Caustic Ka 50 deg only requs 200 ohms reduces to

May 31 1882

20 shewing lessening Res —
addition little sulphur 5:4
to right 500 ohms added
~~reduces recs to~~ def to 20
on strap 1 deg shewing
high resis works relay
~~pretty~~ strong

500 ohms 14 on fine Coil
14 on strap

May 31 1882

Bichromate Potash couldn't melt. (Iron & Carb Electrodes) would not work. 140 Ohm W U Relay got a deflection to the right of 42 deg on fine coil with 500 S Units Then strangely only 2 deg deflection showing very high resistance. Afterwards added some caustic Soda, then it would not work either relay nor give any deflection. It seemed to destroy it entirely.

[signature]

May 31 1882

Chromate Lead. requires high heat to fuse it, Would not work relay. 12 deg left 500 ohms, Only 2. deg. in strap with no res, Eats the iron strongly. Afterwards added some phosphate of Sodium fused again to a liquid this only gave a deflection of 24 deg. on fine coil with no res in. On strap it only gave 2 degs. in both cases deflection to the left

Rex

May 31 1882.

Bi. Sulphide Sodium

fused, at pretty high heat,
This worked relay very well,
and on Galv. with 500 ohms res
it gave a deflection to the
right of 34 deg, and on the
strap it only gave 14 deg
with no resistance showing
it to be of pretty high res.
Noticed that it eat the
iron quite strongly

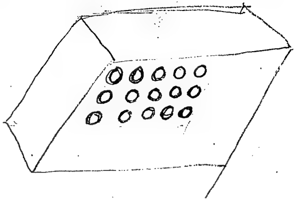
May 31 1882

Epsom Salts, this decomposed at a high heat to a white powder, tried it ~~~~ on the relay and Gal. but could get nothing, I then added some Caustic Soda then fused it to a liquid.

This at first on Gal. (fine coil) gave a def. to right of 4 deg, then it went to left 3 4 deg. and on strap it gave, 4 deg. defl. to left. (Neither Electrode was attacked)

May 31 1882

Sul acid pure & BiChrom
pat 40 deg lift 500 ohm
20 deg in strap no res, dont
work in Lay - requires fearful
heat to fuse it =



Ferrocynide Pot, fuses Easily, would not work relay. On gal, fine coil with 500 ohms, gave a def of 4 deg to right with no res gave a deflection of 50 deg to right,

Then added some Caustic Soda, but it did not help it any, then added some Phosphate Sodium with no better results,

Neither Electrode was attacked,

June 1st 1882

Acetate Lead.

Takes fearfull heat to fuse it tried it on relay 18 gal. and it was N.G.

I then added some Caustic Soda this made somewhat better, It would not work Relay on Gal. with 500 ohms gave a deflection of 18-deg. to left with no res, deflection of 6.6. deg. on the strap no res. gave a def. of 18 deg. did not attack time Elect

June 1st 1882

B. Carbonate Pot Keeping
High temp. to fuse
Would not work relay
on fine coil of Gal. when
500 ohms res. nothing but ∞.
I decreased res. of gradually
up to the left and when all
the res. was out it gave a
def. of 3.6 deg., On the Strap
nothing, showing high res.
Carbon Elect. was eaten away some
Afterwards added some Lime
this gave me a def. to right with
500 ohms. 4 deg.

June 1st 1882

Sulphate Zinc fused quite easily but soon cooled leaving a white powder - Probably Oxide of zinc, Tried it on Relay and it worked it very well. On Gal. with 500 ohms gave a def. 38 deg to right. I then added some Chloride Amonia then with 300 ohms in, got a def. of 38 deg. I then cut out res and got a def of 68 deg to right

5.0 S -

1 SE = 0,9536 Oh

5.0 ~~48,6~~ 8.0

48

June 1st 1872

Chloride Ammonia,

NH4 decomposed by heating, to a powder I then added some Phosphate Sodium, and fused it to a liquid. this worked bang up. Got a good Current. on Relay and on Gal, fine coil 5.0 ohms res. 38 deg with no res. 60 deg. def to right, both Electrodes was attacked, ~~[illegible]~~ the carbon being pretty badly eaten,

June 1st 1882

Yellow Prussiat Pot
Easily fused. Would not work Relay, but on Gal. fine coil 5/6 ohms Res. def. 8 deg with no Res. 54 deg. to right and on cooling off it went to left and gave a def. with no Res. 38 deg with Res. 2 deg. Elect. not attracted.

~~Added Bi-sulphite Soda~~ but it made no difference also added Lime with the same results

June 1st 1882

Took some common
linseed and a treat that
brought it up to a red heat
I could not get anything
from it, I then added
some Caustic Soda, and
heated it up again, stiring
it well, Then I got a def.
on Gal. fine coil. with no
Res. 40 def. and with 50
ohms. Res. got a def. of 10
deg to left. but it would
not work W. Kelvey

Over

June 1st 1882

Scrap Zinc very easily
fused this was N.G.

Also tried scrap lead with
same results added some
Phosphate Sodium but did
not make it any better
did not get any current
from either one

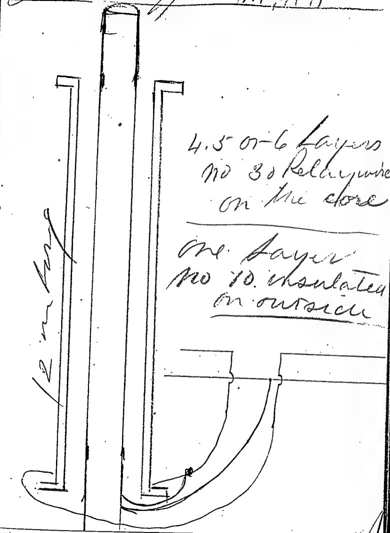
June 30, 1882

June 2. 1882

Common ~~table salt~~

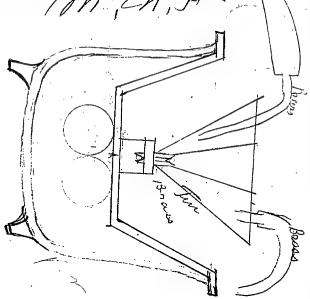
May 1882

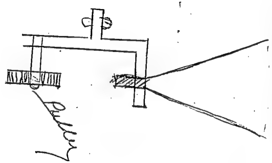
M.N.T



4.5 or 6 Layers
No 30 Relay wire
on the core
One Layer
No 10. insulated
on outside
12 in long

June 26 1882
M. N. F.

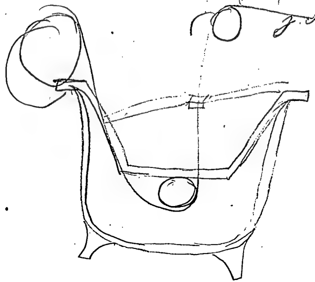




June 28 1882

M.N.F.

J.F.O.



Sept 30th 1882

Experiments tried for building up ends of fibres,

Drilled small pieces of bast ~~fibres~~ and cocoanut shell. also split some of them two thirds down with a saw. Then put the bamboo fibres in with sugar-coal Tar and Japan then carbonized them. but in every instance I found the ~~the~~ substance used contracted twice that of of fibre leaving the high points in contact only

~~Sept 3~~

Oct 2. 1882

Wound some of Clarks O.N.T. No. 100 Spool Cotton on the ends of fibres then boiled Sugar and carbonized.
This came out in a spongy mass

Also drilled and split bast fibres and fastened with resin and carbonized
In carbonizing bast fibre warped leaving poor contact

Oct 2: 1882

Also took a small strip of parchment paper covered with Japan and wound around the ends and carbonized.

This carbonized in 20 ales leaving fibre loose

Also made filings of Bamboo, White Holly Box Wood, etc, then saturated with coal Tar then pressed in a mould

This carbonized like a honey comb, but carbonized closer to fibre

Sept 2 1882

also. drilled holes of graphite and put fibre in with coal Tar and carbonized

Due to the difference of contraction ~~[illegible]~~ the fibre came out loose

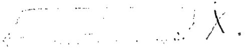
Test ... M. A. Fibres

Bamboo Ends

Long one put on with Coal Tar

Next " " " " " Japan
" " " " " Pitch
" " " Boiled Sugar
" " " " " Plumbago & Tar

Long one Pitch & Tinned
" " Coal Tar
" " Japan



Two box moving Ktow
One short fibre put on pitch 1 box
wood filings
Two boat fibres put on with pitch

New York Dec 2, /82
M. N. Force

Secondary battery Expr

Took some Oxide of Lead (Small amount) and mixed it with a minimum amount of dextrin made a cylinder of it then put it in a tube and passed gas through the tube and kept heating the tube with a bunsen burner until it was reduced to metallic or finely divided lead

Works OK

George Gibbs.
Thomas P. Conant
TAE
J. F. Ott

New York Dec 4/82 and 5th

Mr M. Force

Made some more of the same mixture and put a lead wire through the center to make connection to. But this did not work so well, as the lead wire running through the centre melted or seemed to waste away

Mr Edison sugests that the cylinders be made hollow and pour the lead in after the cylinders have been reduced.

J. F. Ott.

TA Edison

New York Dec. 9th 1882
M. N. Force

Insulating commutator brushes by plaster Paris.

Made two brushes of copper wire fifty wires in each brush and insulated them with plaster paris.

July 21 1884 TAE

[illegible]

Carbon [illegible]

[illegible]

also [illegible]

K also [illegible]

[illegible]

also [illegible]

Very [illegible]

[illegible]

[illegible]

July 21 1884 TAE

[illegible] strong [illegible] 4 [illegible]

[illegible]

heating there is strong [illegible]

bubbles [illegible]

only 7 [illegible]

[illegible]

July 21 1884 TAE

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] only 10 [illegible]

[illegible]

[illegible] Black [illegible] manganese [illegible] —

July 21 1984
MMF

Dne of [illegible] Experiment with Carbon - Plat a .51 Tung Sul [illegible] heated air passed through - to supply oxygen to Carbon works fairly

Twice - Flame Sulphur Carbon & Plat. Not good

July 22 1884

Not strong only 3 degs with no resis. shows its not the [illegible] from the PeroxMn but actual Contact,

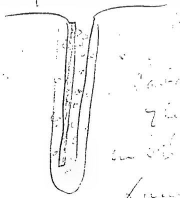
Woman

Wanda

Wandary

Terrafine

July 22 1884



Lamp ...

& Sul acid

Splendid given 10 deg

through 37 ohms res!

we put porous partition

powdered Carbon in Contact

in Carbon & Peroxide on plat

etc But porous partition Cons

res

July 22. 1884 -

We now try [illegible]

[illegible]

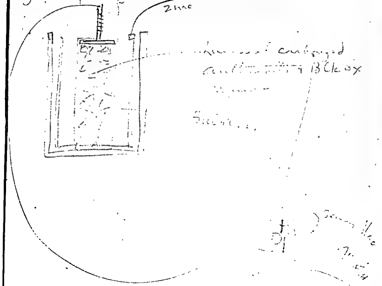
[illegible]

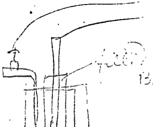
not much def —

Sul a Perox Barium
Carbon + [illegible]
gives good deflection but
unstable all ox comes off

We now try per oxide lead

July 23 -





July 23 1884

blacked Carbon with [illegible]

[illegible]

String [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] get

[illegible] nearly [illegible]

~~[illegible]~~

then suddenly [illegible] Zero

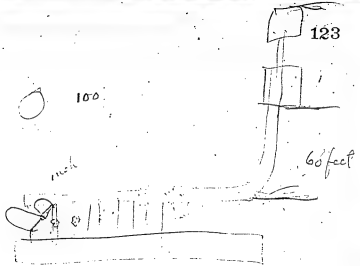
July [illegible]

Replaced [illegible] Battery with
[illegible]
with [illegible] [illegible] +
[illegible] [illegible] carbon
Electricity [illegible] + [illegible]
[illegible] 100 [illegible]
[illegible]
with [illegible] for 11 1/2 —
12 [illegible] — 1220 12 [illegible]

July 23 1884 —

Blackoxman Cone packed with powdered Coke — Zinc & Carbon Dilute SO_4 —

11½ 12 25 pm — pelanges goes to 7½ at 12 27 stays at 7½ 12 30



15 pipes inch dia.

1/2

50. 100.

16. 150. 50. 150.

30 1/2

60.

30 ... 50.

1

55

Jersey City

Elector repairing 150. m'd

Eng. & fireman 1 man 75

9 line men (10) trimming,

6 mos' run 100 lamps 55c per night

Cleared 2200. [illegible] don't cover

Repair,

Baxter Lamp Co.

plant cost 30000, and

15000.0 100 [illegible] 135

Lamps - Everything ; next

place putting in 200

plants, Balls of Reading

Direct production E from Carbon Expts.
10s scaled Sul acid, in glass tube
with leading in platina wires
one pole platina other Wallace
Carbon, put Lumps black oxide
Manganese crude with 104
ohms in ckt gal went to 8 @ 9
9 only after while when tube
Exploded violently - it went
quickly to 8, There was too
much water in acid - going use
Strongest acid then try =

Tried phosphoric anhydride +
peroxide Manganese, gal
went to 3 without recoloring
Cell cracked its very syrupy
must try in Crucible as glass
melts + ---- over

July 28 1884 TAE

Its acts on perox mang to form a Violet colored Substance,

We now try caustic Soda + also Caustic potash from Stickes -

Note = With Sul acid I think the action is either 1 of 2 ways:
Sul acid Decomp to SO_2 + O
O Combines with Carbon to CO.
SO_2 reduces O from per oxide to form SO_3 - or Water of Sula decomp + O Combines with Carbon to CO + H reduces O of peroxide Mang to form H_2O.

July 28 1884 TAE

Caustic Soda & peroxide
Mang crude — cracks glass
when put in large lumps: —
we now powder & put in —
it goes up to 12 with lab's
peroxide, but with 7
ohms only 5. longer heating
make it go down nearly to
Zero with no Res, there is
evidently great deal Oxy
given off from peroxide Mang.

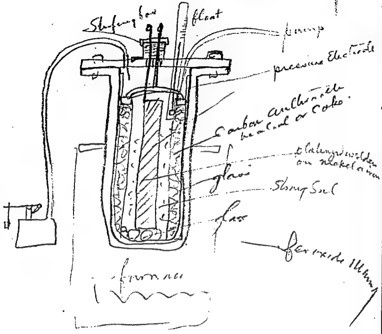
July 28. 1884—

We now try some Nordhausen fuming Sulphuric acid with ~~peroxide~~ Mang Crude ~~with~~ plat & Carbon Electrodes heated ~~to boiling~~ in ~~test tube~~ Cell, this acid is as bad as 3 square Miles of HeCl. Martin got burnt on the face;

no better than Cond 27 @ 30 ohms 10 deg —

July 28 1884 TAE

Boiler large Scale for direct
Conversion Carbon into Electricity



July 28 1884

Thingets try in direct
Conversion Carbon in Co E.

Peroxide Palassium fuses higher point
than Caustic K at white heat decomp
into K monoxide & O, use this,

Also Sodium Dioxide,
" Calcium Dioxide
" ~~Strontium~~ "

for withstanding of Hot Veil or

Chromoso-Chromic oxide formed by
Electrolysis Solution Chromous
Containing Chromic Chloride
by Current Low intensity
black powder insoluable in any
acid Cr_4O_3 -

July 29 1884 Continued

Chromic Dioxide soluable only in Concentrated Sul acid not in acid with 16 @ 17 pct Water

Lead Chromate in SO_4

Molybdenum trioxide fuses red heat

Tungsten trioxide

Antimony trioxide & pentoxide

Bismuth trioxide fuses red heat

Sul Zinc when heated decomp to $SO_2 + O$ this takes place same temperature as heating perox manganese

July 29 1884 Continued

for withstanding Sul acid heat

"on heating to red heat only the neutral Sulphates of the alkalies of the alkaline Earths & Lead remain unchanged. At the temp of Melting iron the two latter Classes are decomp but alkaline Sulphates Volatilize undecomp. Zinc & manganous Sulphates are so difficult decomp that in practical work considered fireproof

Phos anhydride boils above red heat

July 29 1884

108 now try dilute Sul acid)
about 30 @ [illegible]

it works OK - not anymuch
dif from Carc

108 try in crucible in forge
Sul acid & Blk ox, ok but
fumes so bad of SO_3 that
Martin Spit blood + I was
nearly overcome, Borax acid
+ Blk Ox mang not good
NaO + Sesqu Fe ng current
from plat same with MnO_3
~~do~~ tried Sul Zinc + MnO_3
ng — tried lot things ng

13 8

1 lb 33000 for 1 hour

9000000 300

27000000

5000. 60

300000

2)270
135

135
5
675
200
75
50
25
10
50
1085

Zinc Carbon — porous Cup — M, 4, 2

No 1

Water with Sul acid. — zinc in porous cell. Black oxide Mang & powdered coke, — ½ & ½ — 20 cc sulphuric acid in Water pour some water with Sul strong in it in porous pot let ~~me judge~~ of quantity;

2nd

Water with Chloride ammonium porous cell carbon powdered & black oxide manganese, ½ & ½ use Coke —

3rd Water with Chloride ammonium in porous cell use — powdered Coke ½ & other half ~~of equal quantities~~ of Chlorate Potash

July 29 1884 MMF

4 - Chloride Ammonia in Water
porous cell mixture Coke, 1/2
other half made of equal
quantities of Chlorate Potash
& Black oxide manganese

No 1 - The stuff in porous cell being
mushy molasses like -
on strap ~~__~~ 23 gives 10
deg 90 ohms thro 190 4 1/2
2 1/2 through 390 - Very powerful
on 3 ohm Sounder shortckt)
10 o clock night 29th -

July 29 1884

No 5 Sul acid Water.

mixture Chlorate Potash

+ Coke =

No 5 8 on strap 90 ohm

10 deg - 190 ohm 5

2 $\frac{1}{2}$ 390 ohms -

after 10 minute 15 on strap

Shortckted at 1015 pm 29th,

No 4 battery 90 ohm 10 deflec

5 on 190 ohm 2 $\frac{1}{2}$ on 390 ohm

10 on strap - Shortckld

at 1030 night 29th

No 2 July 29 1884 M.N.A

10 deg on 30 ohms 4 deg
on 90 ohm 2 $\frac{1}{2}$ on 190 ohm
2 $\frac{1}{2}$ deg on strap, very
poor on Sounder, short[ckt]ed
at 1050 night 29

No 6 — Coke & Black ox
& Hydchloric acid weak
strap 14 90 ohm 10
190 ohms 5 390 ohm
2 $\frac{1}{2}$ very strong on
Sounder, shortckt'd at
11 pm 29th —

at 11 10 pm Reading of

No 1 - July 29

Strap 10   50 ohms 10

90 ohms 6.   190   3°

290   $1\frac{1}{2}$°

---

11 12 pm 28.

No 5 = 90 ohm 9° 190 = 4

390 - 2   Strap 17

No 4   Strap 5   11 15 pm 28

10° on 60. 8 on 90 ohm

4 on 190 - 2 on 390

No 2 — 1117 pm 29 July 7 884
M.N.A.

Strap $1\frac{1}{2}$ 10° on 10 ohms

palangos shaking Carbons makes it go up

No 6 — 1118 pm 28

Strap 12 10° on 70.

8 on 90 4 on 190 ohms

$2\frac{1}{2}$ on 390 —

---

old Cell that was shortcktd 2 nights & now been 1 hour shortcktd

24 ohm 10 degs — $2\frac{1}{2}$

Strap 5-6 shaking Carbon loosening it & pulling for Same 304 .30 ohm 10 deg

M (ie)

No 2 July 30 — 1884

9.00 am

10 deflec thro 12 ohms.

No 5

50 ohms 10° 90 ohms $5\frac{1}{2}$

190 3° Strap 10.

No 1 strap 4

30 ohs 10 deg 70 - 5°

170 · 3°

No 4

13 ohm 10 deg 53 ohms 3

---

old [illegible]

13 ohms 10 deg

30th July 7.40 pm —

105 4 on strap

30 ohms 10° — 5° on 70

2 on 170 -

---

104 - 7.43 pm —

Strap 1/2 - 10° on 4 ohms

---

102 7.45 pm —

1/2 on strap 10° on 3 ohms

---

106 — 7.47 pm

Strap no [illegible] 7° no Res

30th July - 748 pm —

No 1. Strap. $2\frac{1}{2}°$ 10 or 13 ohms

Reg Carbon Cell shortcktd

9.30, July 30th

~~[illegible] p. 18,~~ strap 9°

~~80°~~ 10° 37 ohms. 77 ohms $4\frac{1}{2}°$

No 1	Time	Strap	10 through line	Time ~~Re~~	Strap	10 through line
No 1.	10, pm 28	23	90			
No 5	1015 " 28	8	90			
4	1030 28	10	90	No 1 & 4		
2	1050 28	2.5	30			
6	11 pm 28	14	90			
No 1	1110 pm 28	10	50			
" 5	1112. 28	17	97			
4.	1115. 28	5	60	5 & 6		
2	1117. 28	1.5	10			
6	1118 28	12	70			
	9 am 29	38	113			
Burner No 1	930 am 29	4	33			
" 5	" "	10	50	5 & 1		
4	" "	—	13			
2	" "		12			
No 1	740 pm 29	~~2~~ $\frac{1}{2}$	13			
5	742 "	4	30	5		
4	743 "	1/2	4			
2	744	1/2	3			
6	—	00	00			
No 1	12 noon 30	3.5	20.			
" 5	" "	1	13			
4	" "	0	000 10	cleaned it out		
2	" "	0	2	cleaned it not		
6	—		gone up	— cleaned		

: No 5 twisted Carbon
around, 8 30 pm – ~~29~~th = 4 ni strip
10° ~~30 ohms~~ – 40 ohm added
little water =

July 29 9 pm –
New Cell, No 7 –
Chloride ammon in outer cell,
Carbon packed with crystals
Chlorate K + was wet with
water – Chlorate K being
insoluble – ammon chloride –
10 [illegible]
12 connected at 9 pm July
30,

July 30. 9 pm

No 8 = [illegible] the porous
cell filled with [illegible]
[illegible] then wet with sol
$1/2$ H_2O + $1/2$ SO_4 - poured [illegible]

.09 ohms 10° deg .20 % 5°
507 3° — $3\frac{1}{4}$° on strap

---

9 15 pm 30th Shop Carbon [illegible]
.01 . given 10° thus 30 ohm.
$3\frac{1}{2}$ on strap put fresh
[illegible] SO_4 in cell [illegible]
[illegible] 7 deg — 30 15° —
Shaking & adding [illegible] water
54 ohm 10° 8 on strap
9 30 - 5 on strap - [illegible]

10.

50,

1	600
2	300
4	150
8	75
16	37
32	18½
64	9¼
128	4½
256	2
512	1 [illegible]

July 30 1881 0.30 pm —

No 9 - Carbonized packed

[illegible] size [illegible], [illegible] crystals

[illegible] [illegible] put in

[illegible] diluted ½ [illegible]

[illegible]

[illegible] 30° in [illegible] —

130 ohms 10 [illegible]

~~Short-ckted~~ 10 o'clock pm

30th =

Nitric acid + packed perox mang + Carbon — Nitric [illegible] cell —

Fill above with [illegible] in pe[illegible] lead —

Try Chlorate K in previous use potash, sol.

Phosphate Soda · also Sulphate Ammonia

Try test tube of fused borax. plat + Carbon —

Storage battery with fused Borate Lead — Various Electrodes

12.

4.

24
36

35
12
1840

No	Time & Date	Shapdrift	10° through — Ohms	Remarks
7	12 noon 30th	1	8 –	Cleaned [illegible]
8	" "	10	37	
9	" "	10	24	
Blinder		7	20	
No 7	9th 29 9 pm	12	~~50~~ 30	
8	" "	34	109	
9		30	130	
8	5 30 pm 30th	7	17	
9	"	8	26	
1	"	4	20	
5		$2\frac{1}{2}$	15	
Blinder		6.	22	
	12 noon 31			
No 1	" "	1½	7	cleaned [illegible]
5	" "	2.	17	
8	" "	2	12	
9	" "	8	30	
Blinder	" "	5	20	

~~4½ lb per [illegible]~~

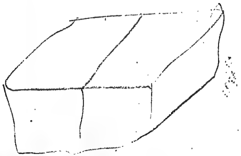
1 lb per horsepower, 4½ lbs Chlorate.

$4\frac{1}{2}$
16. c =
———
20.

~~500~~

4 lbs -

12c



Bergmans Battery

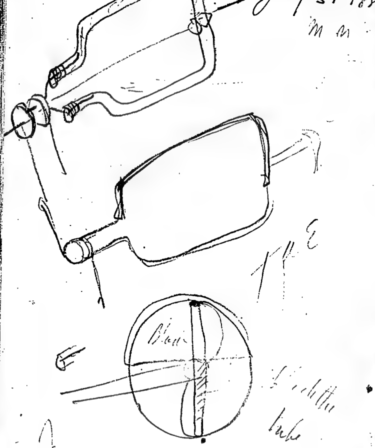
Amal Zinc SO_4 + H_2O —
porous cell 5 oz Chlorate
Pot + Sul Acid —

18 on strap new porous
cell — 90 ohms 10 deg
defln —

Ditto with Coke + Chl pot
+ strong Sul Acid
110 on strap tremendous.

130 ohms 10 deg —

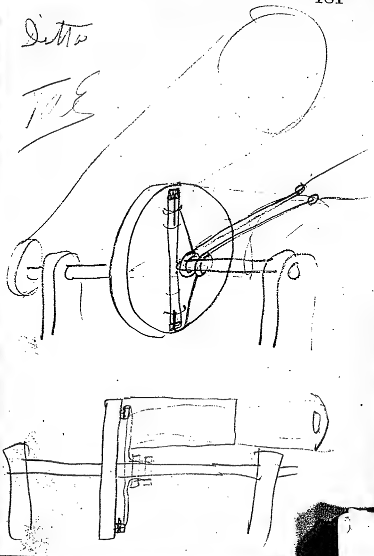
July 31 1882
M N

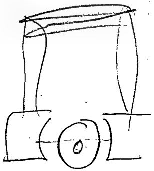


For turning light into electricity

Ditto

TAE

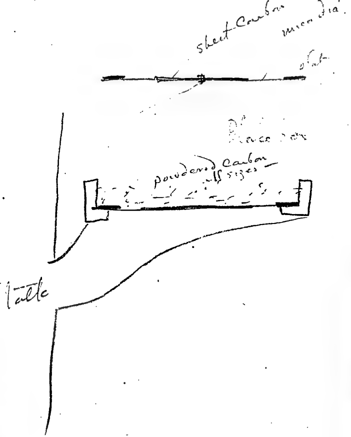




Oct 8 1884

Telephone Experiments. TAE

Telephone.



Oct 8 1884

Telephone Expmts

We now try with trans on 187. with 2 BTCos Cells a regular Edison coil, hand phone, then we change by switch over to a reg Edison secondary but have 10 diff primaries that we can slip in running from No 16 17 18 20 21 22 24 26 28 30 wire, to obtain best resolution for this trans & battery =

Edison Reg loudest -

64 ohm coil		5 times weaker		
34 ohm		3	"	"
24	"	3	"	"
12	"	2	"	"

Telphone Expts.

7 ohms.	~~to~~ 1/2 loudness as reg	
3.25 "	3/4	"
1.28 "	4/5	"
.44	nearly same	"
53 "	5/6	"

Lower coils not so loud

We are now winding lower res Coils.

The Coil twice as long is about same as regular perhaps not quite so loud

We try Experiment of adding battery to each coil of dif res until its same loudness as regular Edison

1st 2 ohms BTCo Cells –

1.28 primary coil. – with 2 BTCo & 1 Carbon as loud as regular with 2 BTCo & 3 Carbon Hurts Ear but only the [illegible] is very loud –

3.25 ohms. with 4 cells ~~[illegible]~~ 2 of BTCo 2 Carbon loud as regular – with 6 louder & clearer with 8. no louder

7 ohms. 5 cells louder regular.

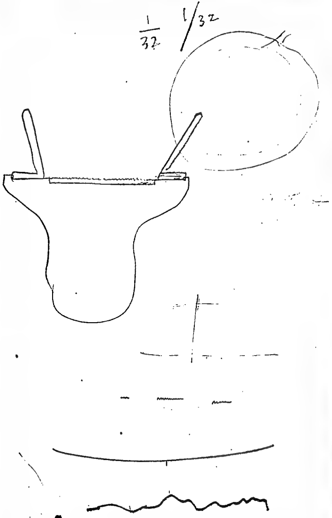
Oct 8 1884

12 ohm 8 cells 1/2 as loud
as regular

24 ohm poor with 8 cells

12 ohms 8 cells 1/2 a loud
as regular
24 ohms poor with 8 cells

Oct 8 1884 Marion
Tried rubber ring with
a two paper Diaphragm
1/32 inch apart filled
with fine coal carbon
the articulation was
good but not loud
except in one position
this was lost after
talking a little while
John Ott is now
putting some lamp
black between them



Oct 9 1884

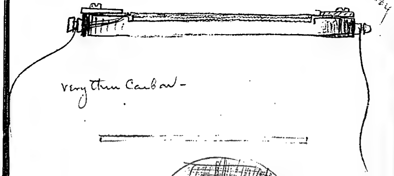
TAE

I think I have clearly in my mind the
proper theory of constructing a loud telephone
& the most powerful utilization of the whole
voice to produce the maximum change of
resistance, It is this use a hard button
of Carbon crosshatched to give innumerable
points have this button 2 to 4 inches in diameter
resting on a hard flat metallic surface
connecting with one pole - over the button
have a soft yielding sheet such as chamois
oiled cotton etc faced with platina foil
or Carbon paper foil - secure the edges
only to prevent moving but do not
stretch in the least let it lay dead
on the button now have a very low resistance
primary, & talk direct to the soft
sheet, the strength of the sound wave
is the same in every part of the soft
armature hence unlike a diaphragm equal
pressure will be placed on every part of
the Carbon & the whole power of the voice
used to make the initial contact,
while with heavy foil or diaphragm
the pressure is great at one spot, but one
does not get the full benefit of all the
pressure as the Carbon makes its greatest

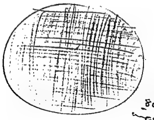
Oct 9 1884
TAE

Change in the first part of the wave, doubling the pressure scarcely makes $\frac{1}{5}$ change further & so as while with my arrangement the ~~1/2~~ initial sensation of the Carbon is only used.

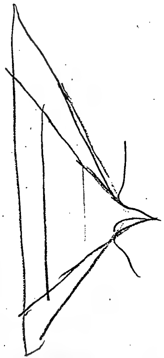
Didnt turn out so well as expctd Oct 11 1884

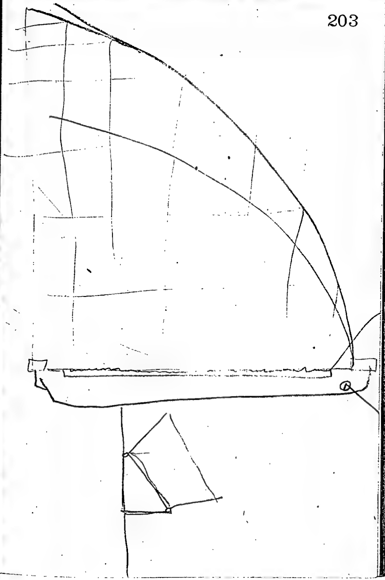


very thin Carbon -



much finer than this 80 @ 100 to inch.

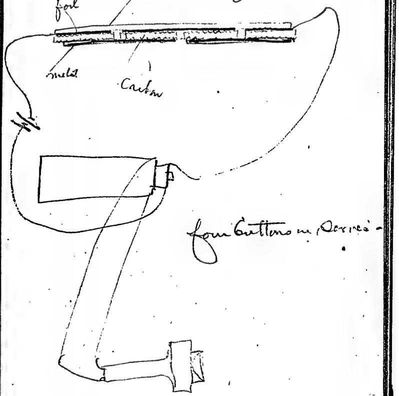


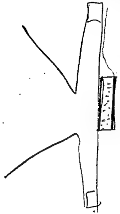


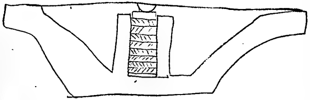
Oct 9 1884

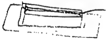
TAE 2.15.05

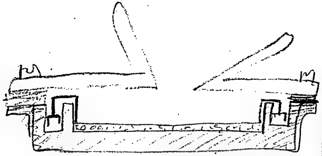
Chamois — or oiled silk or Cotton
(1?) Linsealed —



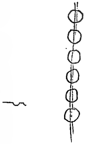


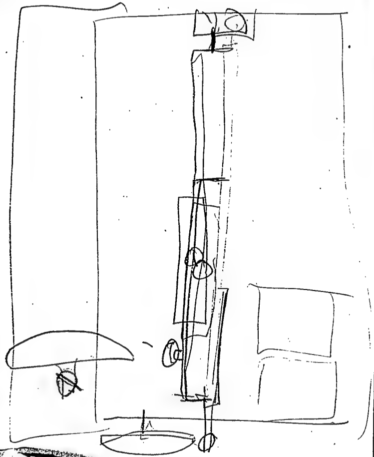


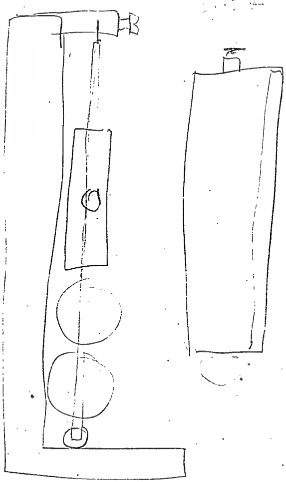




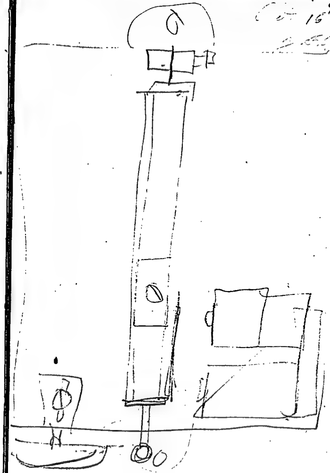
J. F. Ott







Oct 16 84



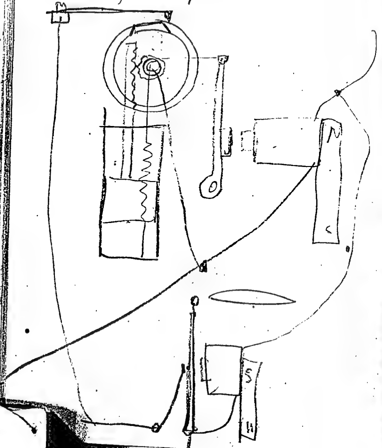
Oct 12 1884

Selenium Signalling

Telephone

TAE

J F O



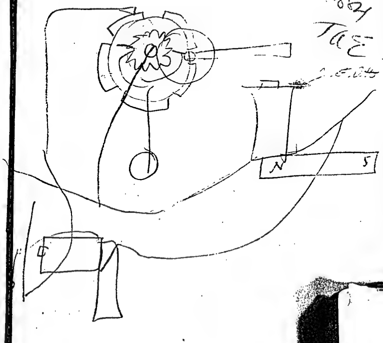
Selenium Signalling

Telephone

Oct 12 1884

TAE

J F O



Washington
Nashin
Wa
Harrington

Barrington

Telephone

Yorick

Yorick Experimental

Square plate Telephone

Celluloid

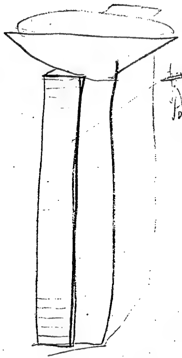
75¢

~~2.00~~

~~[illegible]~~ Balloon

To peanut

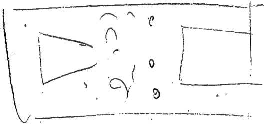
pkg —



[illegible]

[illegible]

Thomas A. Edison



[ITEM FOUND IN BOOK]

Martin

Try the following only bringing them to a [illegible] at first & if they don't work increase the heat so that the Carbon rod will get a little red a short distance from the surface of the liquid.

first try with the Sounder afterwards with the galvanometer using the two binding

(2)

Posts ~~that~~ has the paper in = ~~the~~ galvanometer should stand at Zero when no current pass.

note the deflection on the galvanometer ~~[illegible]~~ and the kind of Jack there is used.

Use the Clay crucible as that used.

[ITEM FOUND IN BOOK]

Common Phosphate Soda X 44

— o —

Sulphate Potash, if nec put in some saltpetre -

Saltpeter or Nitrate Potash or Nitrate Soda, if nq. add Red Lead -

Caustic Soda 3/4 - Bichromate Potash 1/4 =

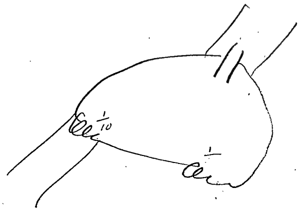
Sulphate Lead X 40
afterwards put in pieces of Caustic potash.

~~Sulphate Lead~~ & Caustic

Caustic Soda 1/2 - Black oxide Manganese 1/2 -
Stir well -

Chloride Lead -
afterwards put in 1/5 Caustic Soda,

[ITEM FOUND IN BOOK]



Menlo Park Notebook #204 [N-82-05-26]

This notebook covers the periods May-July 1882, March 1883, and April 1885. The entries are by Edison and John Ott. Some of the entries were witnessed by Charles T. Hughes. Most of the material relates to electric lighting. Included are drawings of armatures and notes and drawings of automatic voltage regulators, lamps, and meters. Included also are notes and drawings of the sextuplex telegraph and notes relating to a process for compressing bran. A few pages appear to have been used by a child for drawing, writing, and math exercises. The book contains 278 numbered pages.

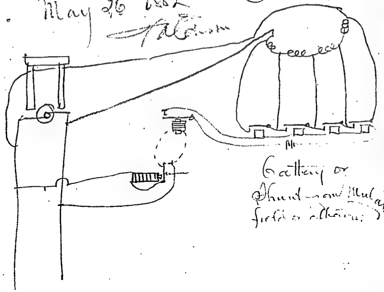
Blank pages not filmed: 8-9, 80-89, 112-119, 126-137, 144-147, 150-151, 154-161, 170-203, 208-237, 256-261, 266-271.

Missing page numbers: 97-98, 109-110, 273-274.

Automatic Regulation

May 26 1882

T A Edison



Battery or
Shunt ... field ...

Works bang up

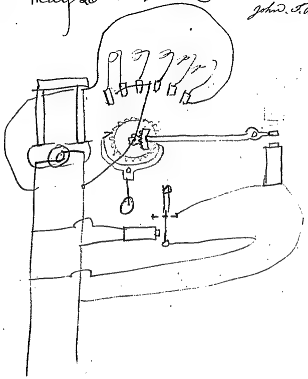
Edison

John F. Ott

Automatic Regulation

May 26 1882 TA Edison

John F. Ott.



250 | 6000
5000
250
250
40

36 El

8.

6
3

3

372.

.32.

2.16

.250

12.

6/66

~~450~~

2.50.
50
12
60
3.72.

20.
4
2
40

1

4

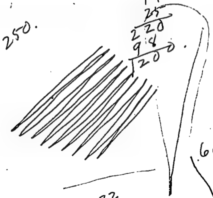
25

44
25
220
98
200

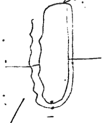
250.

3

50
5
250



3.



.600.

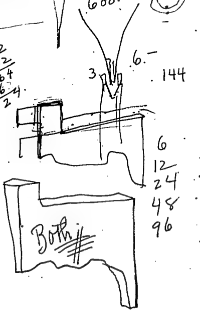
6.

3

.144

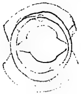
1600.

32
32
64
96
1024

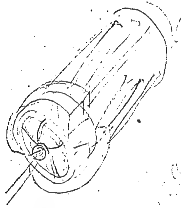


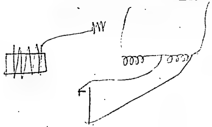
6	1
12	.50
24	.25
48	.12
96	6
	.4

Pour Cotton's on parafine
Flox -



indicator





1½ to 70.

4000.

1000

10

3.

20

40

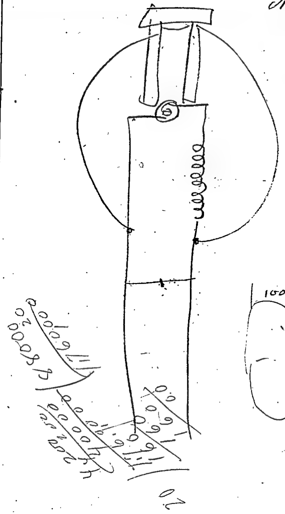
1 40. 40

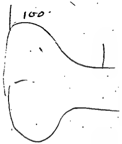
20

¼ $\frac{1}{5}$ ½ 1

May 31, 1882

John F. Ott

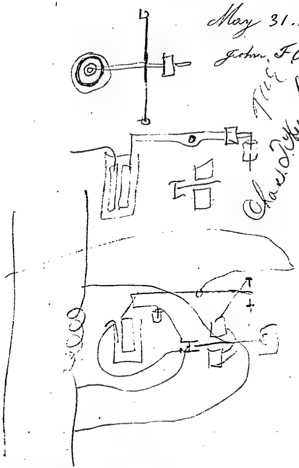




May 31. 1882

John F. Ott.

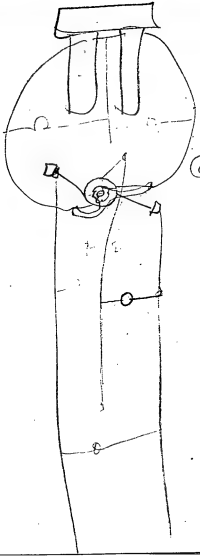
Chas. T. Hughes



May 31. 1882

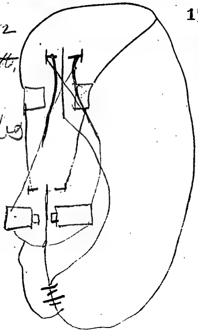
John F. Ott.

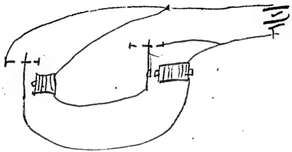
Chas. T. Hughes



$12,25-

May 31, 1882
John F. Ott,
Chas. T. Hughes



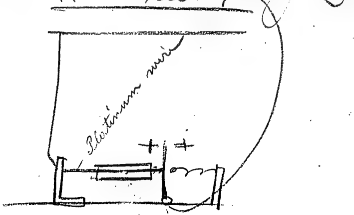


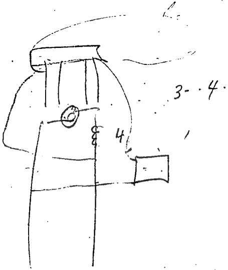
5

May 31. 1882

John F. Ott

Chas. T. Hughes



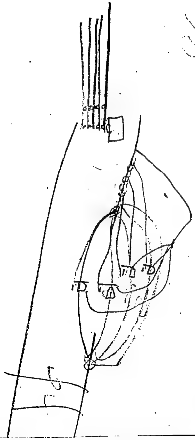


May 31. 1882

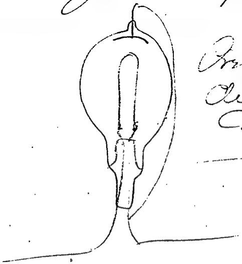
John F. Ott.

Wit

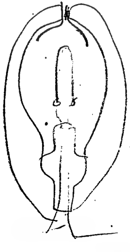
Chas. T. Hughes



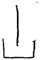
July 5 1882
TAE



Prevent
Electrical
Carrying



30 Lamps 11 less ½ bat,



Lamp		Sec	
35 =	12 strokes	50	
35	12 "	51	
			10
40	12 "	40	
		39.	
		39.	5
45		34	
		34	
		34	5
50		29	
		29	2
55		27	
		27	3

60.	24	
	24	
65	21	
	21	3
		2
70	19	
	19	

Curve on dash

~~pot magnet meter~~

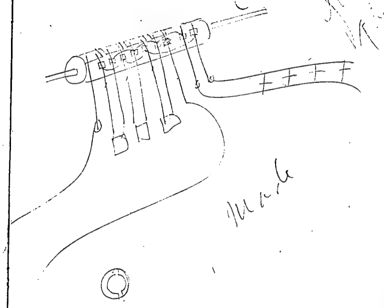
with Beam

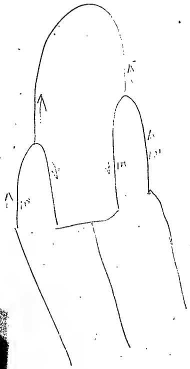
T A E

July 5 1882

John F. Ott.

1000, 975 75 90, 115

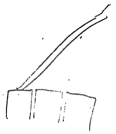


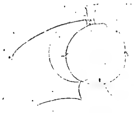


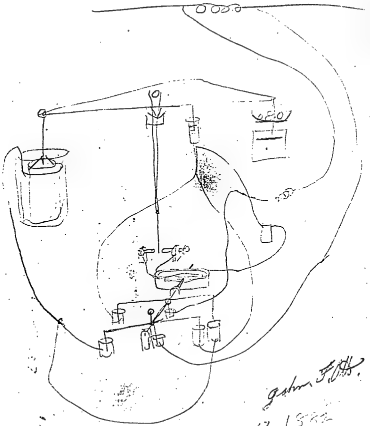
June 12 1882
TAE

Stick [illegible]
on by sealed drying
oil & japan Varnish

In the [illegible]
Celluloid or Nitrated
Cellulose or Nitro Benzol
or Nitro the ends of
the loop & then
attach with a Saline

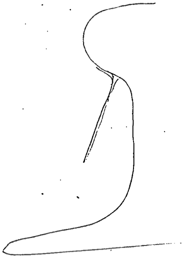




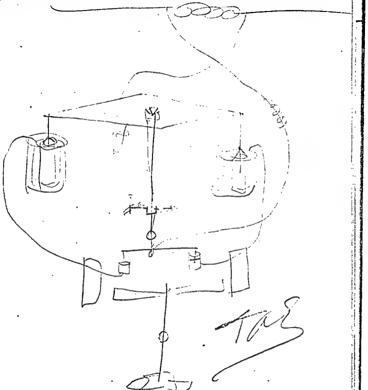


John F Ott.

June 12 1882



June 12, 1882
John F. Ott

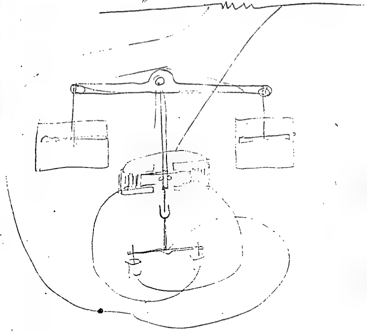


TAE

25, 5.

June 12. 1882

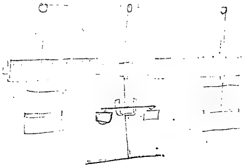
John F Ott.

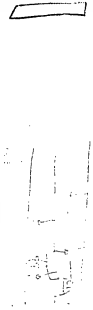


T A E

June 12, 1882
John F. Ott.

TAE





June 29 1882

TAE

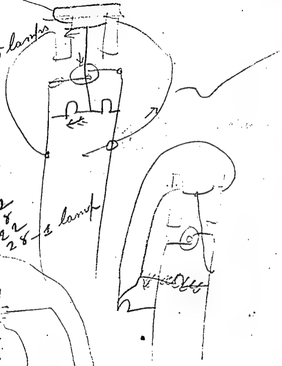
John F Ott

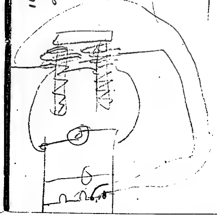
Tested June 29

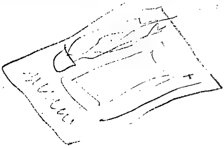
Def

170 — 75 lamps
175
176
182
187
19[illegible]
196
201
206
212
218
222
228 — 1 lamp

10 Bell gave def 14 1/2
one cell 1079





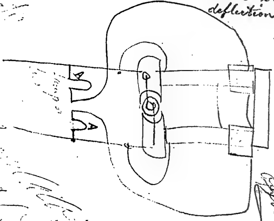


Lamp System

With 2 lamps marked A in circuit it gave the following deflections

Lamps	Def
75	170
70	171
65	175
60	182
55	188
50	194
45	200
40	205
35	210

July. 12. 1882

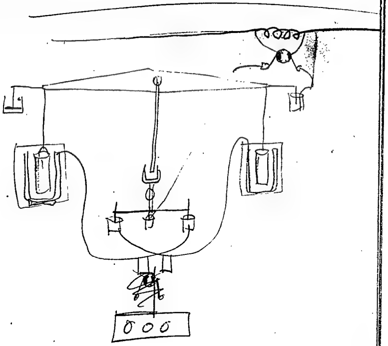


opposing coil

Automatic Regulators

Automatic Regulator

John F Ott



John Ott Have [illegible]

July 5 1882 [illegible]

J. F. O.

450 | 1350 (3
1350

450 | 2375 (5
2250
125

450
5
2250
1350
800
2375

250
16
150
150
250

10 | 400

3

2
250
1350

450 × 100
16
160

160 | 500 (3
480

~~30~~

2
3

35
300
10500

$10000.
45
24.

25-0

14

10 $9\frac{1}{2}$ 9.50 × 3 = 28.50

12

36 to 28.50.

36) 250 (7 to inch

28) 250 (9.

36 × 9 = 324.

325 × 16 = 1950 / 325 / 5-20

7

Continuation of Experiment on page 49.

Conected 4 lights in Mult arc it gave lower candle power, but increased in candle power some raisue as the other.

July 12. 1882

John. F. O. H.

Also tried preasure Magnet in Mult arc. when presure became to high it closed point that closed single point sounder, closing second winding across Mult arc with Main lines. I found that it almost required thee same energy to bring the Magnet down as it took to build it up.

The two lairs on each core measured 5.8 ohms, and I found it nessiary to short sirkit this to bring the lights to a dull red

Magnet Beam dashpot

3500 35.

10000 4.

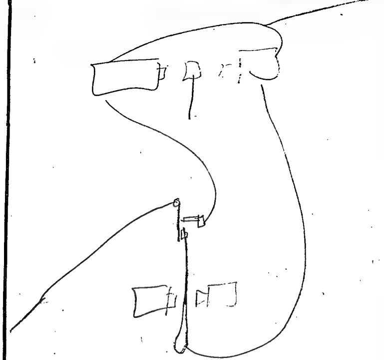
400.

$\frac{1}{100}$

2500 3500 / 100

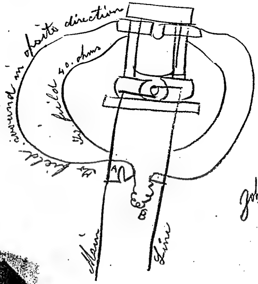
3500
25
1750
700
8750
400)

218
4
8400



July 20, 1882

Tested ~~the~~ following conections as current regulator or pressure regulator A. represents group of lamps. B. Copper shunts or resistance

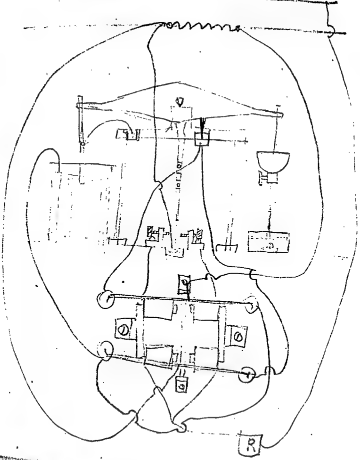


John F. Ott.

$960.173

968.70
1785.08
38901

2909

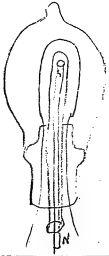


July 20. 1882

John F. Ott.

Tested Weber meter and founde that the mercury chaanged its resistance while working, so much as to give one half the reading, after working half day. under the some condition, or in other words same number lamps same measure

John F. Ott.



Mch 8 1883

TAE

M N F

[illegible]

present [illegible]

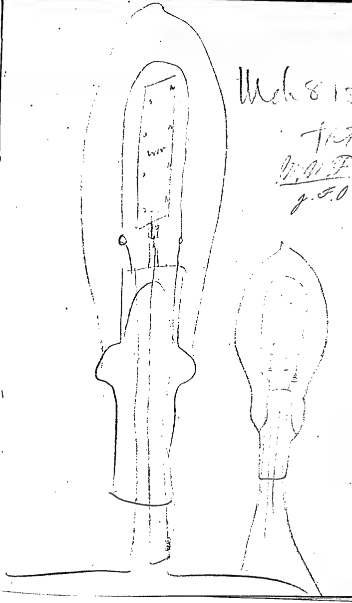
75

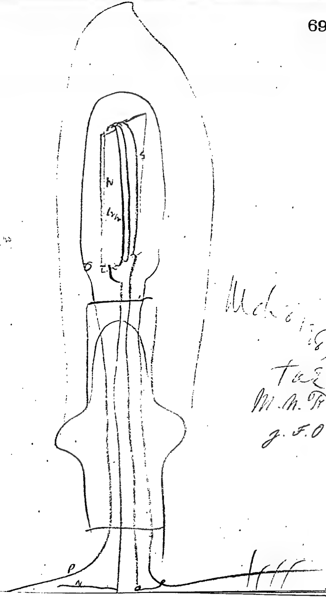
Mch 8 1883

TAE

W.H.F.

J.F.O.





Uchiig
Taz
M.N.F
J.F.O

Lamps Mch 8 1883 — TAE
passed thread through
bragamuth & die —

Made lamp with P filaments
large surface ditto
N — ditto 60th N.Y.P. dont
see much change regular

—

Have ascertained that the
[illegible] of the [illegible] wires
in [illegible] is due to
Electrolysis & conductivity
of the glass — & that lime
glass [illegible]
glass still less than
our regular lead glass
am going make a new batch
of these glasses TAE

Mch 8 1883 TAE

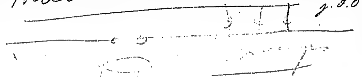
Have ascertained that the Joining
Ends in Carbon can be only
done with [illegible] by the
use of a Carbohydrate
Cement = no Hydrocarbon
will answer at all -

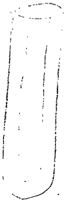
am trying lot experiments
get simple indicating
meter Electrolytic [illegible]
with Hg & Hg solution
of zinc = it is apparently
difficult

Reading Pennsylvania
Local there is a great
need of process of
Compressing Bran —.
I propose that there
[illegible]
Bran from which the
air is exhausted (1e)
the [illegible]
the Bran — this will
[illegible] it to pack —

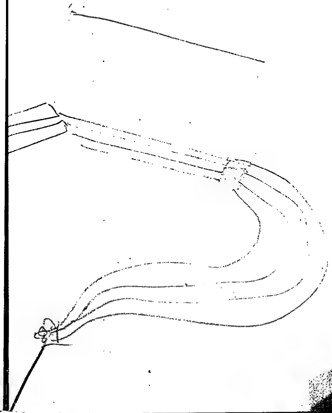
Meter Mch 8 1883 TAE

g.o.o





amalgamated Zinc
wire in [illegible] Zinc
deposit [illegible] side
taken [illegible]
[illegible] weeks
Such [illegible]
Certain [illegible]
hours an El changes [illegible]
replaces a [illegible]
in ckt & [illegible]
cells mean certain Bell
for long [illegible]



10
3
3
4
3
2
2

250
10
2500,

30,000,

40000) 600,000,

12.

20,000

75

4

52 10000
520,000

15

247

1500
50
75000

20

150
20
3000

64

4

10

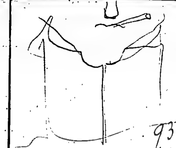
70

64

5

21

1200
9300
10500,



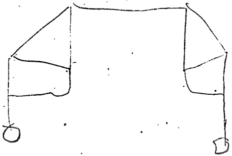
9300
6000
15300
1200
16500
2800
5000
24943

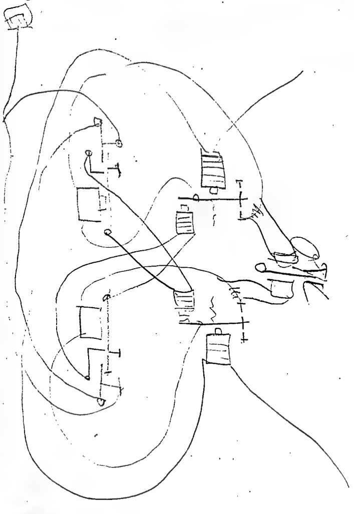
70
4

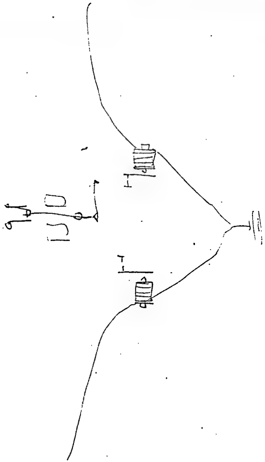
77

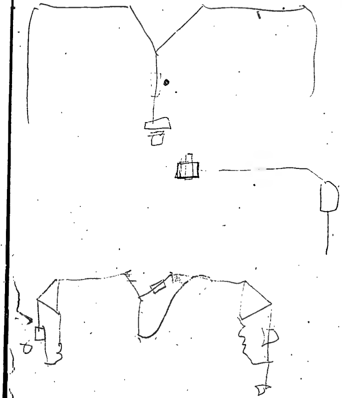
10
4
40

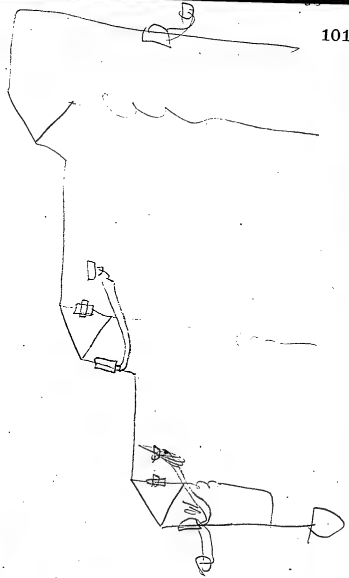
4500
4800
9300

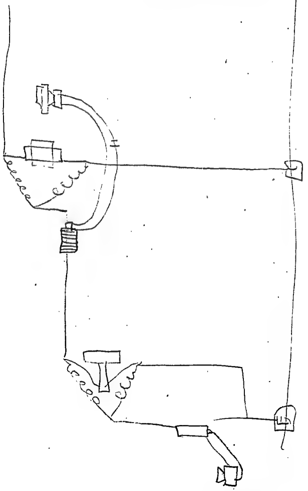


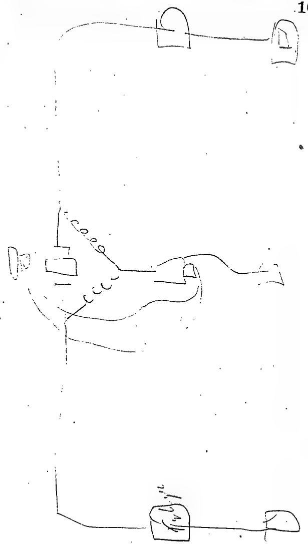


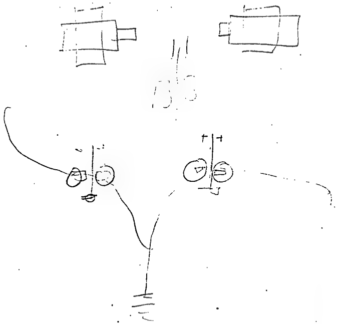


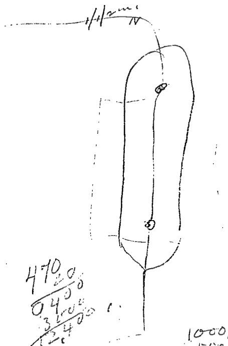










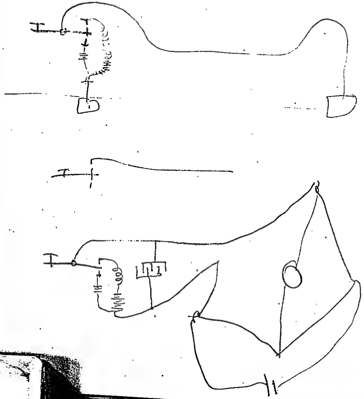


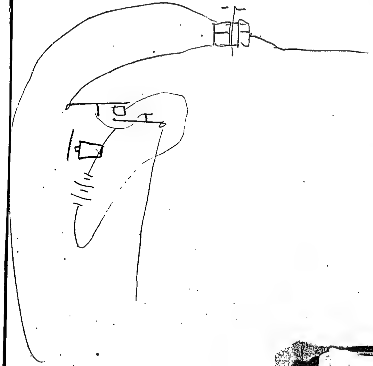
470
0400
3400
1400

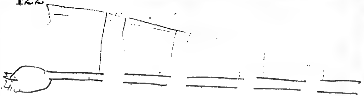
75
56
9
8
60

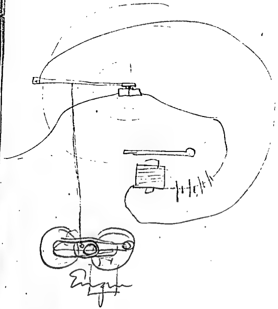
1000,
500
375
600
100
500
3075

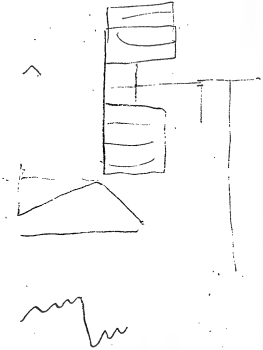
Pelion on Ossa











13
68
55
42

1342
1341
~~2882~~

38
69
11
48
99

5

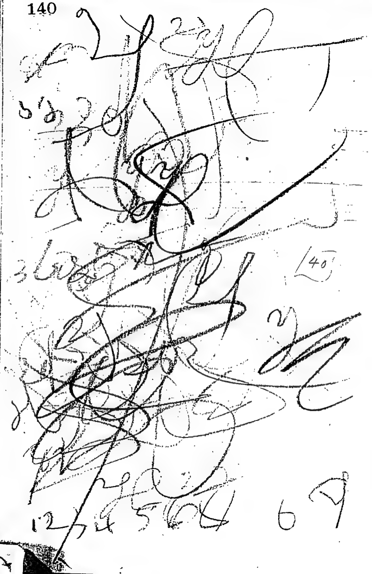
94181
4181
19462

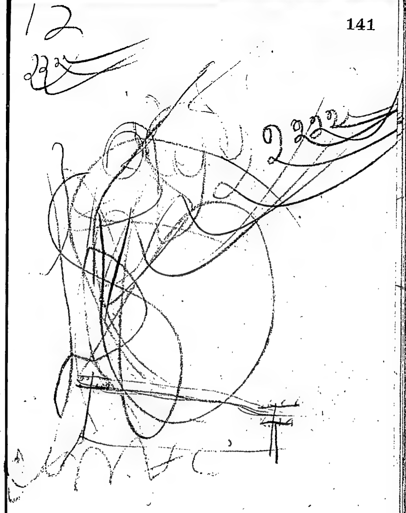
16
16

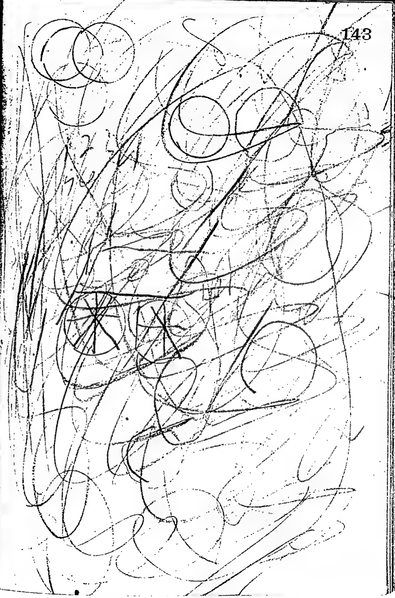
2

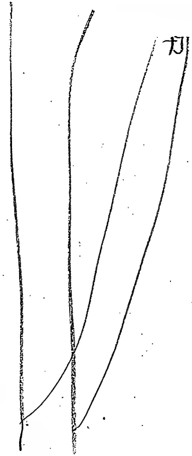
44
44
10
2

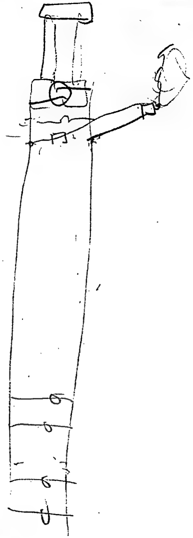
444
4444
4444
4449











'01

110 A 80 90 D '01 10

1000

$\frac{110}{.02} / 110.00$ 5500

5500

20

$\frac{20}{.02} / 20.00$ 1.0

1000

W

90 000 100

$\frac{110}{.02} / 110.00$ 55

$\frac{1000}{.01}$ 10,00

$\frac{10000}{80000}$

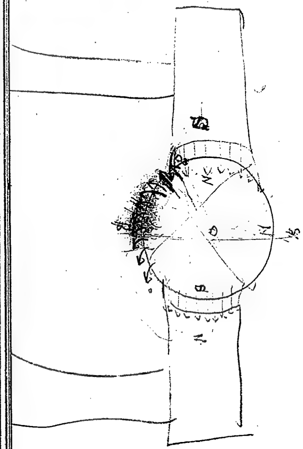
$\frac{20}{.02} / 20.00$ 100

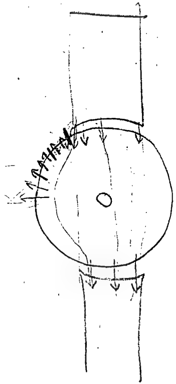
5500 120

605.000 1000

$$\begin{array}{r} 90000 \\ 10000 \\ \hline 80,000 \end{array}$$

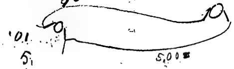
100





90

400 100



5

$\frac{500}{2500}$

$\frac{100}{.02}$ / 10000 5000

$\frac{20}{.02}$ / 2000

$\frac{10}{.02}$ / 500

90
500
746 / 45000
4576

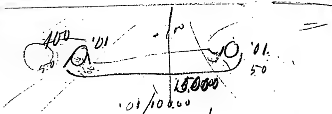
| 60

00

600

$2\frac{1}{2}$ — 9 · —— 1/2

25

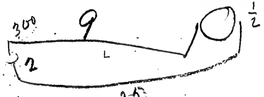


.01/10000

10
02/1000.

500.

600



1/2

63 2½

10

2½
63

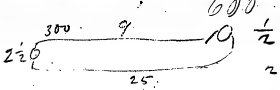
3

25

600
50

600 300

63
25
315
126
1575



1/2

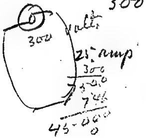
20

10

25
63
25

63 × 25

25
300
7500

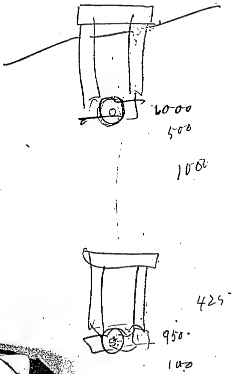


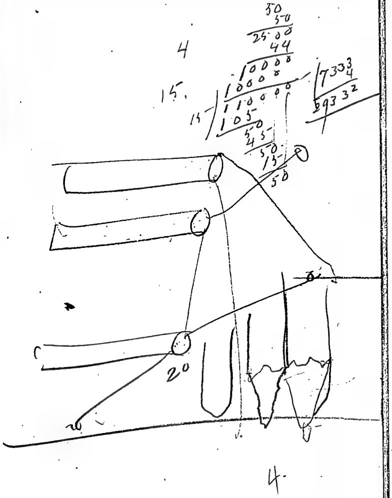
300

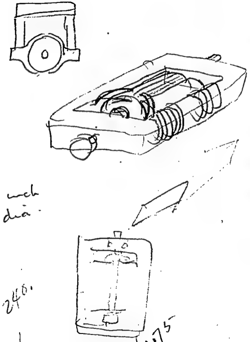
12

300
300
7500
45000

7500


1000
500
1002
425
950
100


4
15.
20
4.



10 inch
4 dia
8

240.

240.

3.75

150
16

240) 900

150
21 1/2
147

21 1/2

23

April 1 1885

TAE

Have Lamp Co carbonize some plates of 1/2 + 1/2 mixture Oxide manganese precip & hard Carbon with Tar as binder plates for Storage

---

also some porous plates Carbon made with Tar, hard Carbon & baking soda

---

See if pure Black Tin Monoxide is Conductor

Try [illegible] oxy[illegible] [illegible] Sulphide Tin

April 1 1885

TAS

[illegible] Cylinder

Beam [illegible]

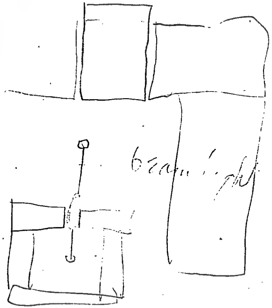
Copper wire Coiled around it [illegible]

I

Beam charges surface [illegible] statically Copper band is [illegible] taken [illegible] gone

Reverse Currents also [illegible]

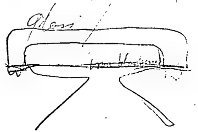
April 1 1885
TAE

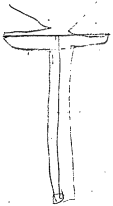


Rubber suspension
Vibrating Cloth for
Experiment

April 1 1885
TAE

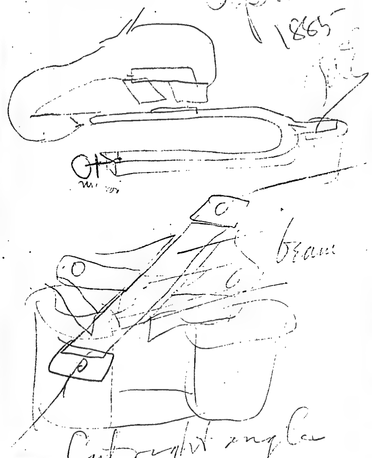
beam light
variable
Expand air



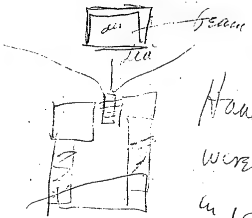


beam light
Hand Rubber

April 2nd
1885

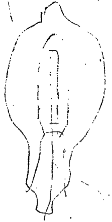


Cut right angles



April 2 1885 TAE

Hancock's wire put in 1 Candle lamp —



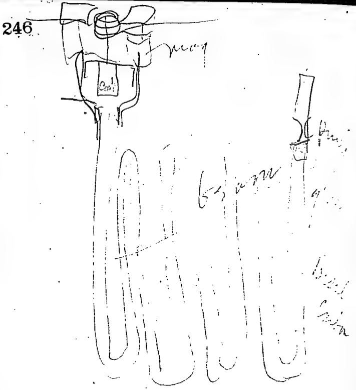
[illegible]
see [illegible]
also magnet
also everything
see [illegible]
[illegible]

April 2 1885
TAE

get some Luminous
paint. put inside
globe Exhaust
high v.c. see
if sensitive to green
also if the daylight will
make it luminous if
so make for ~~green~~
watch clocks see
time day & nights

Look up all the Colored
Salts that are in flat
scales like plumbago &
try Compression & mixture
with clay like reg lead
pencils
Red & blue needed
also try Bronze powder
pencils

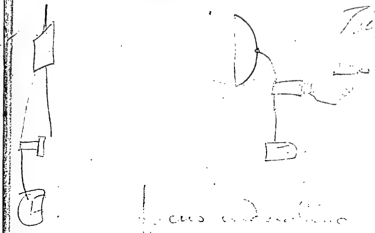
April 2 1885
TAE



in liquid great Expansion

April 2 1886
TAE

April 2 1886
TAE

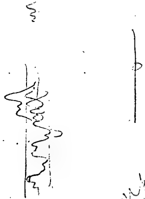


Jars wanting

Current free field
will go as a beam

Quad Cable

April 2nd
1885
TAE

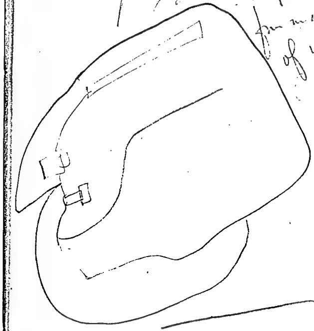


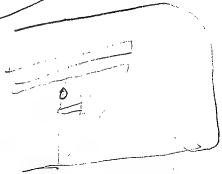
unwinding diaphragm

polyph

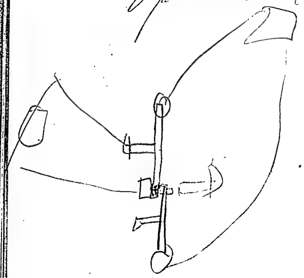
April 2 1885
TAE

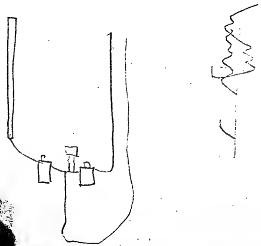
try self-induction
for magnitude
of induction





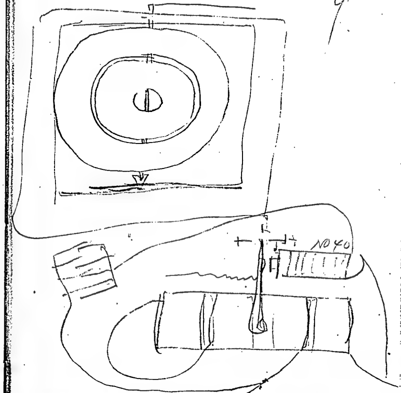
April 3rd 1884 — Tel —

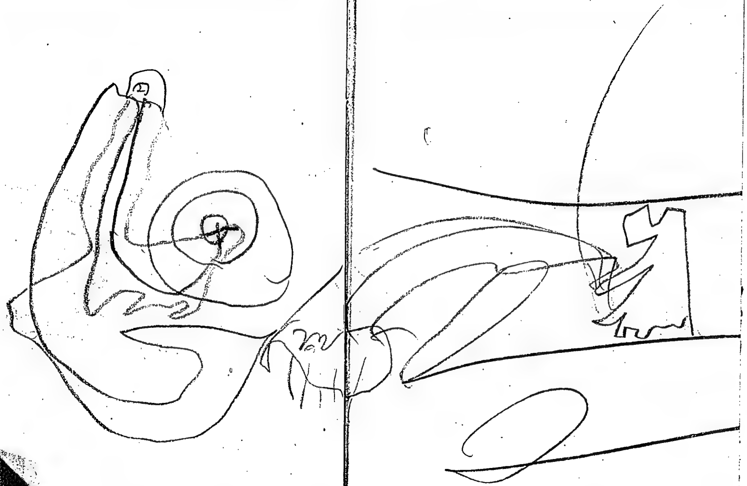




April 3rd 1884 — Tel

Sextuplex relay Coils n.Cy



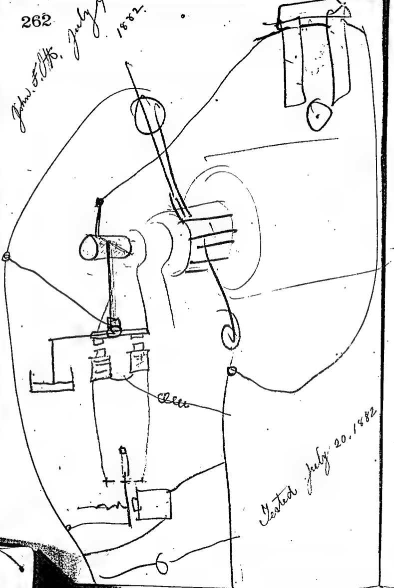


25

6

5

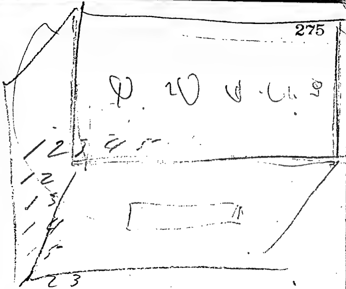
John F. Ott. July 9 1882.



Tested July 20. 1882

Tested regulator on page 262 and found that brake and brush burn out very fast and also regulated by jerks keeping a constant rise and fall to the lights. this cause was not due to imperfect workmanship, but to natural causes

264



1 2 3 4 5
1 2
1 3
1 4
1 5
1 2 3
1 2 4
1 2 5
2 3 4
2 3 5
3 4 5
2 3
2 4
2 5
3 4
3 5

.2110 - 2.10 6%

1.

.16

1.10 — 10%

1 30000

90000

35-000

257000 —

2,900

≠ 1,450 1666

84.4 844

229.4

2900 1666

8% 17

11662

23200 1666

1450 20)28327

20)24650 1416

1232.~~7~~

1416

2648 -

2294

354

30.000 10/-

35.000

15000
20

600000

3

12

35..) 36.000

4.250

12) 103

2.500

4.7 8/6

) 750

10.000

5.83

85/-

29.15

7x) 85000

42

235.

Sore

Off

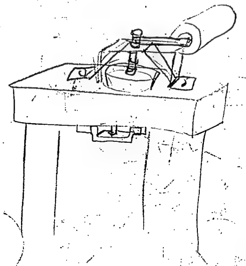
Menlo Park Notebook #206 [N-81-03-09]

This notebook covers the periods March-April 1881, August 1882, and January 1883. All of the entries are by Edison. Some of the entries were witnessed by John Ott. Most of the material relates to electric lighting. Included are notes and drawings of automatic voltage regulators, electric meters, dynamos, conductors, distribution systems, and chemically treated filaments. Included also are notes from various works on chemistry and drawings of telephone devices. The book contains 276 numbered pages. The last few pages have been torn out of the book.

Blank pages not filmed: 22-23, 36-39, 148-149, 152-155, 166-167, 172-173, 176-177, 182-183, 188-192, 197-203, 230-247, 250-275.

Missing page numbers: 157-158, 163-164, 185-186, 193-196, 207-208, 211-216.

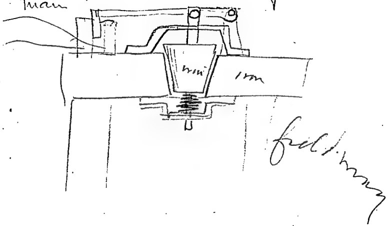
Mch 9 1881
TAE



March 9 1881

TAE
J. F. O

Auto Reg

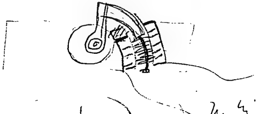


March 9 1881

TAE

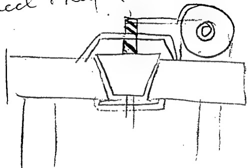
Auto Reg

Patent J.F.O



Main

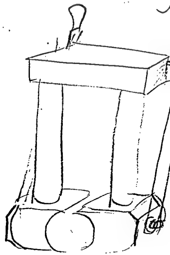
Can have a hand wheel & Reg hand



use this for prime fieldmach to work other fields also for welding

March 9 1881
TAE

2.5.0

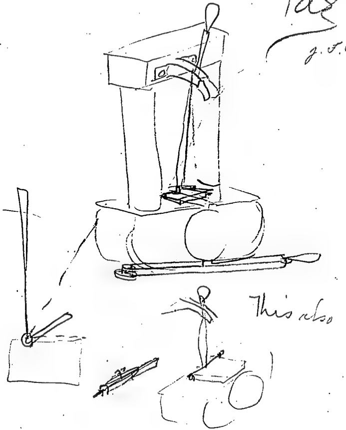


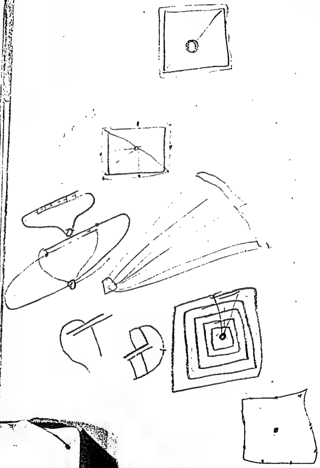
~~[illegible]~~ Regulation

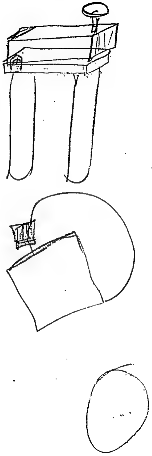
March 9 1881

TAE

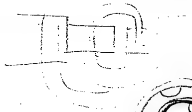
J.U.O

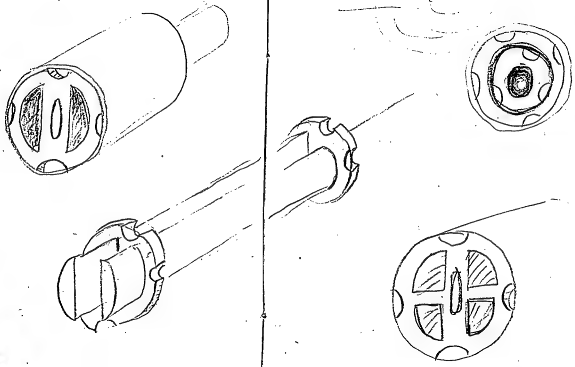




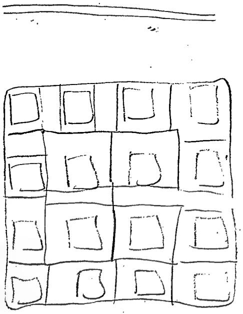


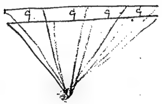
Mch 9 1881
TAE



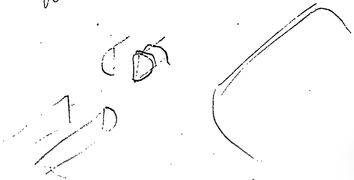


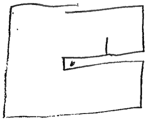
Mch 9 1881





Mch 9 1881 TAE

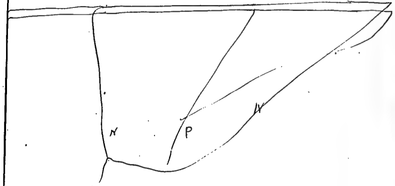


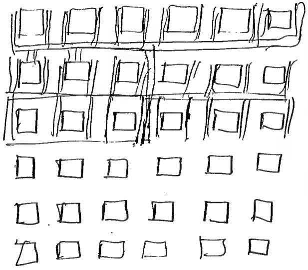


Forrestry

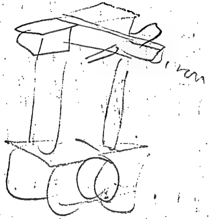
Forrestry

Mch 9 1881 TAE

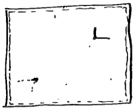


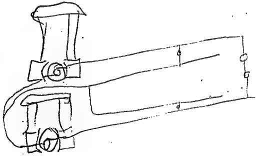


~~Distributing~~
Mch 9 1881
FAE



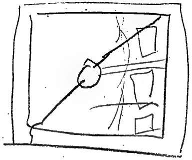
Mch 10 1951





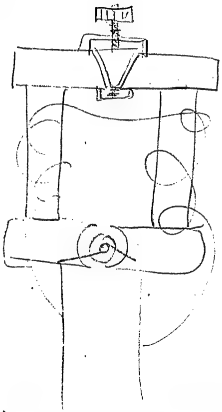
[ITEM FOUND IN BOOK]

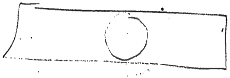
3-wire system 3/10/81 (?)

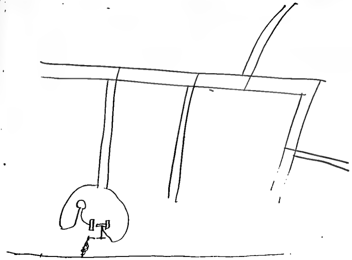


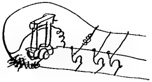
Mch 9 1881

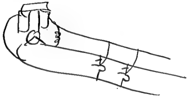
TAE

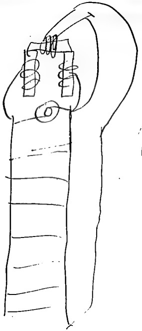












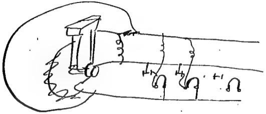
March 14. 1881

TAE

5

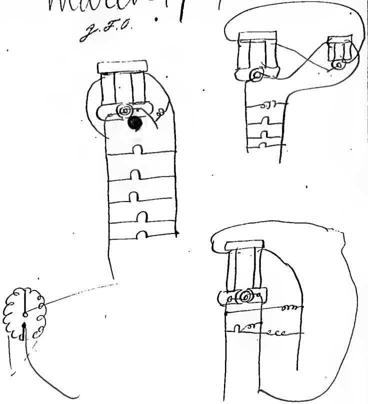
J. F. O

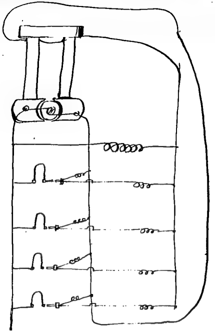
1500,



March 14 1881 TAE

J.F.O.

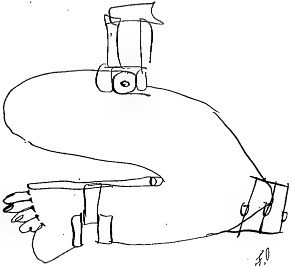




March 14 1881 Matt
for patent TAE
J.F.O

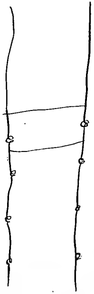
750 feet,
396 Lamps.

1 57 lbs;

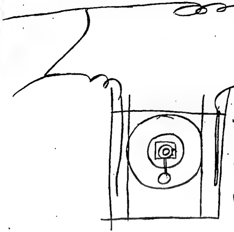


April 3 1881 TAE J.F.O

Self Reg for Dropsent



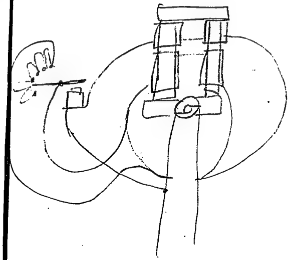
[redacted]



U. S. Patent Office
Edison vs Sprague } Interference Electrical Meter.
"Edison's Exhibit No. 1."
November 17/1885
[illegible]
Notary Public N.Y. Co.

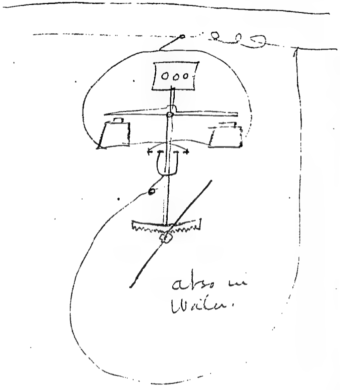
Copper cylinder revolving in a Sulphate Copper Solution, with a weighted Counter within it so that when cylinder revolves Counter will stand still, deposit of Cu on one side & taken off other

April 3 1881 TAE
J.F.O.



Auto Regulation
April 3 1881 TAE

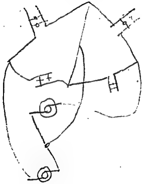
J.F.O

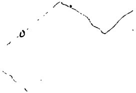


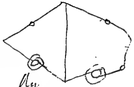
April 3 1881

TAE
J.F.O.

April 3/1881
TAE



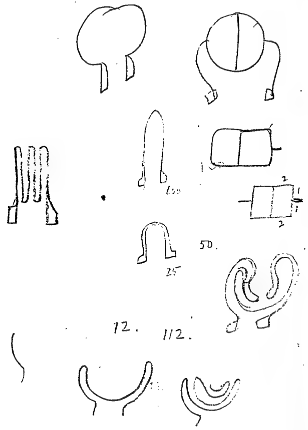


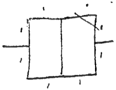


Matt f[illegible]

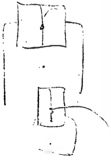
April , 1881
TAE

Auto Cutoff-


50.
25
12.
112.



4 | 2
4



9-

54

12

6 —

6-

2

2

6—

5

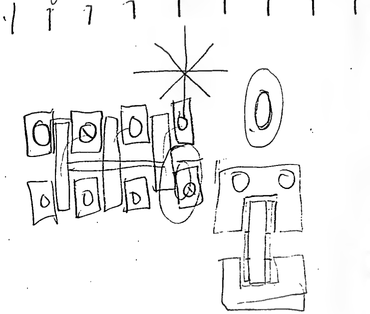
8

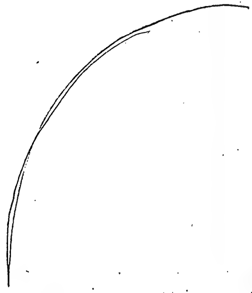
4

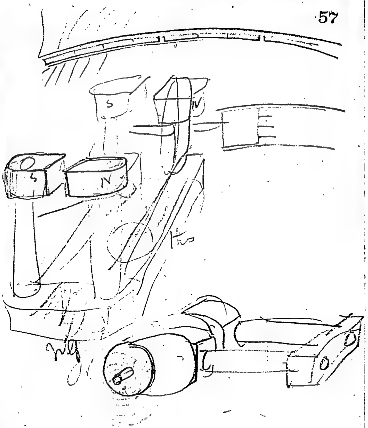
April 14

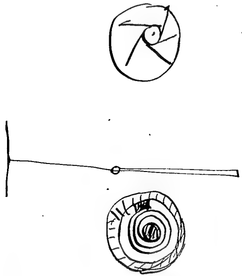
1884 AE

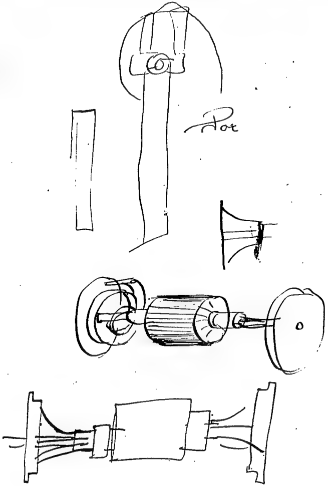
Dynamo






S
N
S
N





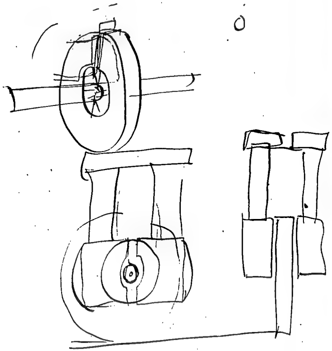
Por

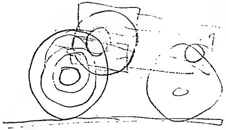
10

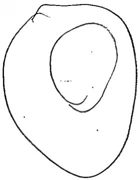
$^{120}100$

12,000. 4000.

0







Aug 1 1882
TAE

Lamp Experiments -

Use Cocoanut charcoal platinized by soaking 5 minutes in boiling solution Bichloride platinum then igniting in plat crucible or holding in flame spirit Lamp, put it in lamp hat + pump out quickly

Zinc Ethyl and Sodium Ethyl mixed instantly absorbs CO: turns Black = Wanklyn says deposit nat Carbon as it dissolves in HCl. See Jnl Chem Soc p 13 Vol IV. No 19 -

Karsten. (see Wm A Miller 107-)

say charcoal made from wet wood has but 14 parts of the Carbon while dry wood gave. from 33 pts 25- pts Carbon but 100 parts wet only yielded 14 pts.

Charcoal charred by superheated Steam 536 Fahr analysed

Carbon	71.42
Hydrogen	4.85-
Ox & Nitrogen	22.91
ash	0.82

Schonbein found that ferric salts reduced in cold by agitating their solution with charcoal powder & Mercuric are reduced to mercurous salts

Berthollet has proved that by
intensely igniting charcoal by the
Voltaic arc in a current of
pure Hydrogen ~~that~~ Acetylene
C_2H_2 is formed

Try lighting a lamp in
pure dry Carbonic acid
to see how long it stands
also exhausted. in which
Carbonic acid is the residual
gas - ditto try these
~~two~~ Expmts with pure dry
Carbonic Oxide CO.

The residual gas of our lamps
is Carbonic acid from the
lungs of the glass blowers

Carbonic anhydride is not decomposed by heating with Sulphur or Chlorine & the Halogens ditto. but if mixed with hydrogen & submitted to a high temp water & CO produced =

Carbonic acid decomp by Sparks or the silent discharge Making ~~CO_2~~ CO & O.

a Solution of Cuprous Chl in HCl or a Cuprous Salt in ammonia gradually absorbs CO is agitated with it but if liquid boiled most CO comes off

According to Bottinger
D eut-Chem, Ges, Ber 1877 X 1122
CO readily absorbed large quantity
by well cooled dry Hydrocyanic
acid,

CO unites with Potassium if
latter heated to 176 Fahr
this is frequently Employed in
gas analysis -

CO unites with Equal vol
Chlorine in Sunlight forming
Carbonic Oxydechloride, phosgene gas

(1) Enters directly combn with
Potassic hydrate when heated
with it forms Formate.

Chloride Silver in powder exposed Current
dry ammonical gas rapidly
absorbed - the Chloride increases
1/3 in Weight. does this at ordinary
~~Temperature~~ - by heating can be
driven out & condensed by ice
in another part of tube

Electric Spark decomposes
ammonia gas 2 nitrogen 6 Hydrogen

Chlorine dec Ammonia at ordinary
temp. liberating N & forming under
certain Circumstances Chloride Nitrogen

Nitrogen Combines with finely divided Boron at red heat also 1 pt anhydrous Borax + 2 pts Chl Ammonia at red heat gives nitride Boron, which is white powder feels like talc & not attacked by heating in either H or Cl.

I think pentachloride phosphorus is even better than phos anhydride as when heated to ~~2~~ high temperature decomp to phos anhy + free Chlorine See Miller 295 - magnesia

Mould up buttons 
from our little mould
of following some hard &
some moderately hard

Phosphate Lime
Magnesia.
Alumina.
Silica
~~Hydrated~~ ferric oxide
~~H~~ Gypsum

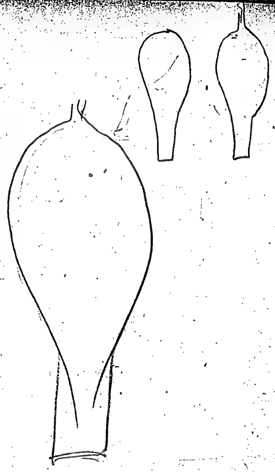
a piece of freshly burned charcoal
exposed to air condenses moisture
rapidly so in 3 days increases in weight
$\frac{1}{3}$

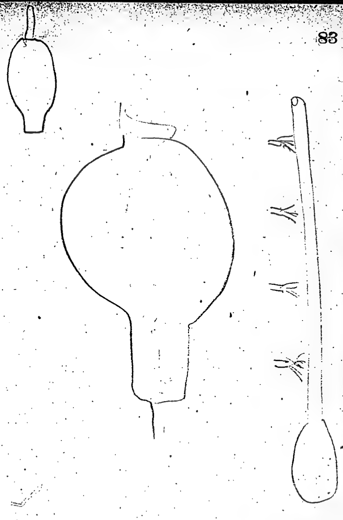
Spongy palladium absorbs 686 volume of Hydrogen but Exhibited no tendency to absorb nitrogen or Oxygen

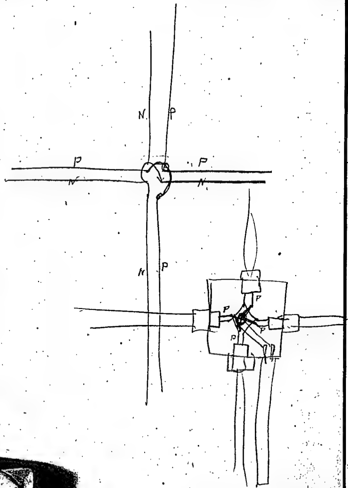
~~Gypsum~~

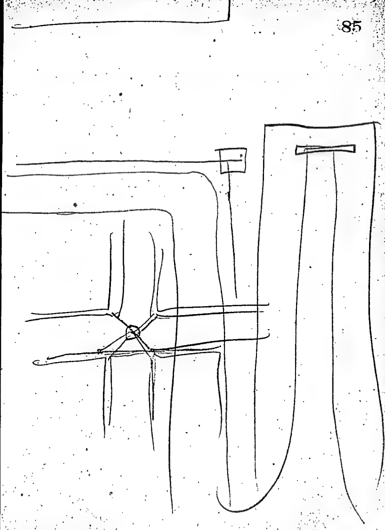
Graham - see Miller physics p 120 - states that ~~that~~ Soft rubber lets in O & scarcely any N. hence on pump residual after while be Entirely O. a square meter of surface of rubber on Sprengel let at 20c 2.25 Cub Centims per min. of which 42 pc was O.

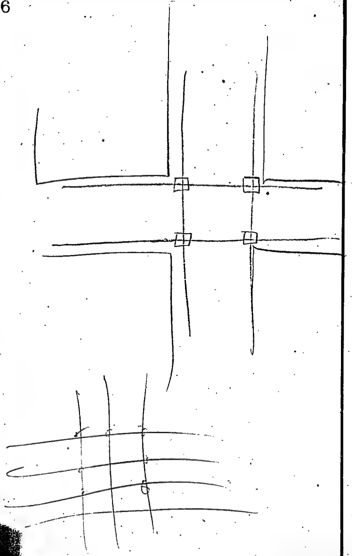
Continued to p. 91

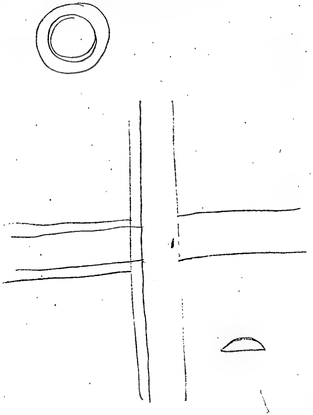





N
P
P
P
N
N
N
P
P
P
P
P







12
1-

12
12
48
72

64) 324.(

24

72
72
144

8

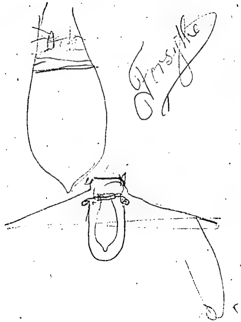
16
5
80

64

504
84.(324

16-) 48
32
64

16-



2001

1001

Caoutchouc like Charcoal
has power absorbing ~~Char~~
rapidly ammonia, Nitrous
oxide, Sulphurous anhydride
See Grahams Experiments in
his Chemistry + Phil Trans.
1866, p 399. also 1863
p 385 -
The gases are frequently
reduced in bulk as much
as would be needed for
liquefaction -
absorption by Caoutchoc equal
times was CO_2 1 H 2.4 -
O 5.13 air 11.8 CO 12
N 13.5 air passed through
the membrane at 4 c with only

$\frac{1}{11}$ the Velocity with which it passed through at 60 C

Might try working sealing in plat wire by our process for freeing air as P take 1.4 vols of H & retains it up to a red –

Copper takes up .3 to .6 its bulk of H.

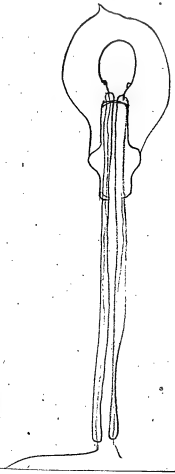
For Secondary Battery try red oxide of Hg Lets go its O by slight heat –

In form of sponge Platinum absorbs 1.48 its bulk while palladium sponge absorbs 90 Vols Hydrogen

The blackening of one of the platina wire (10) positive wire passing through the glass is due to fact that there is a constant spark here which decomps CO to C & free O. its probable that this spark also decomps some CO in Vac & deposits on glass.

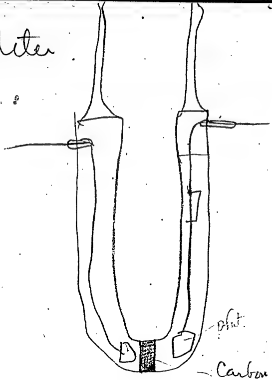
The Hydrates of Sodium, Potassium & phosp anhydride retain their water at any temperature hence in our Experiments use anhydrous K & Na by burning the metal as well as the dried Hydrates

Make an extraordinary long seal to get rid of that spark on p plat wire that decomposes the CO.



5

Meter



Electrical dyalisis transference by diff of EMF.

Bunsen says syrupy Phosphoric
acid dont absorb gases

For preparing absorbent balls
See p 53 Bunsens Gasometry

Fused Chloride Calcium absorb
ammonia gas
Fused KO, absorb CO_2

Bunsen used balls of phosphorus
Cast under warm water

absorption only occurs above 15 or
20 C if aethyl methyl Elayl
or Similar Hydrocarbons be
present Phos must be heated
nearly up to melting point
before it absorbs O

if at commencement Expmt
Phos ball whitens then its
HC if no cloud then no O
Phosphorous acid is formed

Tension Vapor phos-ous acid
which coats walls: considerable
if gas not carefully dried (with
ball potash Bunsen) thinks phos.ic
anhydride best

Bunsen rather recomnds Liebigs
plan of absorbg with Ball of
paper pulp moulded & dried at
100 C & saturated with a
concentrated solution of
pyrogallate of Potash it
absorbs slowly but
completely, particularly if Ball
renewed, but this not Essential

with the small amount O is residual, everything must be well dried, The pyrogal of K is a thick syrupy solution,

to absorb CO_2 the potash ball must contain so much H_2O that its suff. to receive impression from the nail & must be moistened Externally with H_2O before using

Sulphuretted H. absorbed by Coke ball Coated with Sal Sul Cu Lactate aq – Tartar Emetic or other salt decomposable by Sulphted H Sul Cu in form ball or chromate Hg

absorb it slowly

Dry Binoxide Manganese
or peroxide Lead decomp
Sul H quickly + immediately
but Bunsen says they are bad
in gas analyses as they absorb
large quantities gas being porous
bodies, that's ok for us

Phosphoric acid balls made
by dipping plat wire in
red hot cooling sol of
phos-ic acid

~~Binoxide mang can be~~

Ball pure caustic K mainly
also absorbs Sulphide H as
well as CO_2 Simultaneously

HCl gas absorbed by ball

oxide Bismuth, oxide Zinc which formed while moist & then ignited in flame;

Sul Magnesia or Borax & especially Sul Soda answer extremely well balls formed by dipping wire in melted salts melted in their own H_2O of crystalization Specially good when small quantity HCl gas present

Everything dried with phos anhydride.

Bunsen
Carbonic Oxide CO can be seperated from Light Carburetted H - Hydrogen, nitrogen, Carbonic acid & Etc by means of a concentrated solution subchloride of Copper by saturating ball of paper pulp

Olefiant gas (Elayl) absorbed Coke ball soaked Concentrated (but still liquid) solution of anhydrous sul acid in monohydrated Sul acid the acid fumes which difuse through tube are absorbed by KO, fused.

Ditetryl gas (Tetrylene)
Completely absorbed by fuming SO_3 acid

Aethyl same process Ed Bunsen

Plat black absorbs Acetylene

when the vapor of any volatile organic substance is submitted to the electric spark acetylene is produced. ~~Also~~ acetylene is formed in reactions at very high temperature.
Berthelot An Chim+P (4) xxx
431

Shuster absorbed O by heating electrically an iron wire in Vac —
Shuster also used metallic Sodium
1874 — in vac tubes

Favre says denser charcoal dont absorb so much gas as porous

MP v Wilder Deut Chem Ges Ber says acetylene treated Electric spark condensed to yellow oily liquid which after time turns brown no solvent can be obtained

Wood Charcoal placed in one end of sealed tube & heated in boiling H_2O ~~& other in~~ freezing liquid ~~if Saturated with~~ dry Chlorine gives liquefied Chlorine condensed but volatile liquids like Bromine hydrocyanic acid Carbon Sulphide Dioxide Sulphur Ether & alcohol retained with tenacity nothing condensed

Phosphorous either in Vacuo or H CO_2 ArH or marsh gas or N + when exposed to Violet light it 1st Volatilizes + then settles on side glass in form Brown red Insoluble its supposed that either O or Water decomp does this but Gmelin Said precautions taken

Phosphoric Oxide absorbs O + Cl either dry or moist phos acid or Chloride show being formed - When dry this Oxide Yellow + distinctly tasteless or smell -

---

Phosphorus shines from Oxidation in highest Vac - diminishes as Vacum falls - The quality

the rarefaction the less
is
it necessary to heat the P.
at atmospheric press temperature
must be 20 °C

P. absorbs Chl nitrous ox
vapor hyponitrous acid, Marsh gas
olefiant gas or vapour Ether,
Alcohol rockoil, turpentine
Eupion, Creosote or other volatile
oil; because it forms a
Compound with them

Chlorine Combines with H to
form ~~An~~hydrated Hydrochloric
acid which is white - but
How about H_2O in lamps - guess
white Coating will then

Mercury absorbs the whole of
the Chlorine

Cl combines with H by action
Spark

Chl & CO, Combine in bright
light in few minutes forming
phosgene gas $\frac{1}{2}$ the Vol.
its not decomp by the
Elec spark when mixed
with with ~~either~~ O or H
but when mixed with $\frac{1}{2}$
Val O & equal Val H it Explodes
yielding HCl & CO_2
Potassium Causes Entire
disappearance of the gas

one portion absbg the Cl the other
the O of the CO products
Chl K KO + Carbon

Phos sublime but produce
no change in phos gene

Jvs -

Suboxide lead absorbs
O. made by heating
glass tube - oil the
~~tube~~ Containing Oxalate
lead. Dr H has bottle =

Acetylene is the only Hydrocarbon that can be
prepared directly from its free Elements
This occurring when the Electric arc pass
between Carbon poles in an atmosphere of
Hydrogen = It is formed from

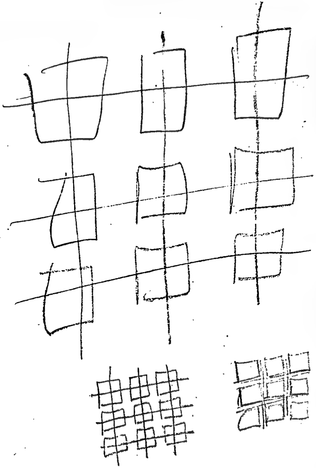
nearly all organic Compounds at a
redheat & occurs regularly in Coal gas
it can be obtained from the latter in
considerable quantities by incomplete
Combustion

Its a Colorless gas — on passing
acetylene over heated Potassium
H is set free & voluminous Colorless
Compounds formed (10) CH. CNa
CNa=CNa which are violently decomposed by
water.

If gaseous mixture acetylene passed
over an ammoniacal Sol of Cuprous
Chloride a red precipitate formed
(Spose ball moistened would answer)

a strongly ammoniacal Sol of argentic
Nitrate - white precip.

Acetylene is absorbed by Antimonic
Chloride. precip.



Chlorine Explodes when mixed with acetylene

acetylene is absorbed by Cold Bromine
it unites with Iodine at 100C forming Crystals · which melt at 70C

platinized asbestos produces Slow Combustions by absorbing
try mineral wool also —

Pumice Stone & pipe clay are slower.
they absorb the produced (?) CO_2

All seem to agree that CO ·
is readily absorbed by Cuprous Chloride in HCl.

CO & H acted upon by spark
after a long time give an oily liquid
which soon became amber color & on heating to 100C became Brown it was

slightly soluble in H_2O giving yellow opalescent Sol having odor of Melacetone mixed with formic acid it reduced mercuric oxide. (How about putting a reducing agent on walls of globe of lamp)

Cyanogen & H with Electric spark combine to form Hydrocyanic acid

Graham says CO rapidly absorbed by x Sol of Subchl Cu in HCl or Ammonia, indeed by ammonical Sols of Cuprous Salts in general the Sulphite x it absorbs it as quickly as Potash does CO_2

deposit on glass may be paracyanogen — its black

CO_2 is decomposed to free O + CO. by electric spark

Nitric Acid acts on wood charcoal to form a soluble $^{in\ H_2O}$ black stuff —

Hydrogen & Nitrogen are very (slightly absorbed) by Cocoanut Charcoal

Hunter = power to absorb diminishes with heat

Chromic anhydride combines with acetylene -
wash bulb (Ic) I mean coat bulb
with it =

CO may be oxidized to CO_2
by Chromic acid introduce
ball. plastic pans soaked
sol Chromic Acid
Concentrate highly - try
drying it thoroughly also higher
temp increases effect

Anhydrous Chromic A Combines
directly with C according
to ~~Berthelot (don't believe)~~
in Vac —
H is oxidized by Chromic acid
using plastic & ball
dip Carbon might answer

here is table of ball
with Chromic a in H

original Val	35.8
15 hours	29
19	27
26	23
65	7
86	00

when the Chromic a is diluted Oxdyn very slow

Ludwig record balls of plaster Paris when absorption agents are not fusible mixing with H_2O & moulding in bullet mould made of which is oiled. The reason they coat with syrupy Phos acid is prevent absorbing gas mechanically (we want the)

Carbon monox uses ball
gypsum steeped mixture
1 vol saturated Chromic
a Sol & 2 vols H_2O
the CO_2 must be absorbed by
potash - The mouth
must be sealed as Chromic a
~~attacks~~ it

---

1 Vol Cocnut Charcoal only
absorbs 4 of H & 15 of N
= Hunter

Dry Acetylene absorbed with
Evolution heat by
antimony pentachloride =
Acetylene is formed by action
Electric spark on many
hydrocarbons.
Acetylene Colorless gas
Combines with Cl explosively in
diffused daylight result
heavy oil -
Acetylene forms metallic derivatives
with fused Potassium forms
black powder = perhaps K of
ash of Bamboo works
Acetylene united with
Copper form detonating
Compound Acetylene in
presence moisture rapidly
attacks Metallic Copper/

Acetylene is absorbed by Copper becomes coated with black substance, (probably low Voc blue before cor dried air doe it)

Napthaline absorbs acetylene

Best Solvent Glacial Acetic A & Absolute Alchol.

Poorer Solvents Turpentine & Bisulphide de Carbon.

Tetrachlor de Carbon —

Berthelot states acetylene only formed by arc not by Induction spark. (perhaps when loop high vacuo & drowned)

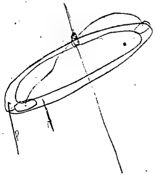
passage of Induction Spark through CO gives acetylene

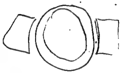
Cyanogen gas offer great resistance to spark

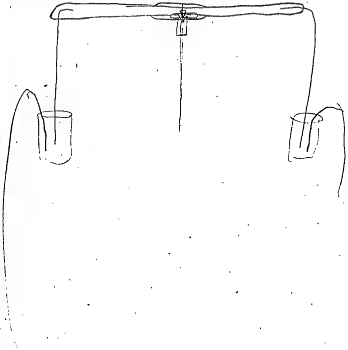
When Induction spark passes through Marsh gas tarry black hydrocarbons are deposited on tube =

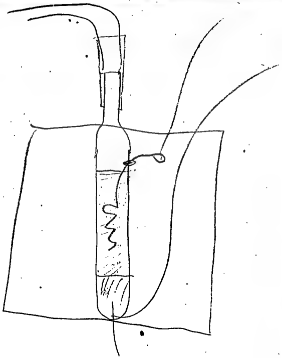
Acetylene is decomposed by Electric spark & deposits Charcoal. Acetylene is formed in all organic Carbonizations =

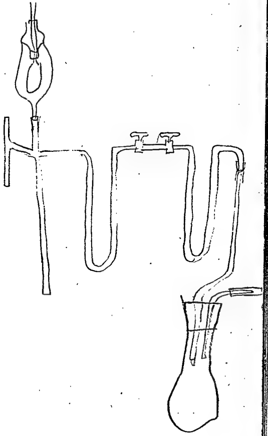
Send for metallic Podassium
Sub Chloride Copper

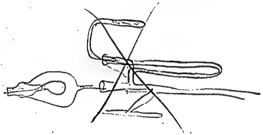


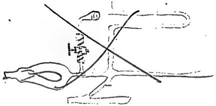


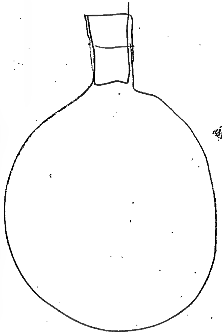


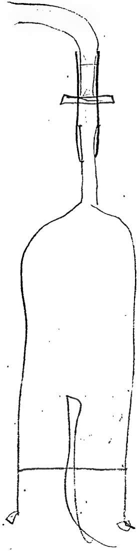


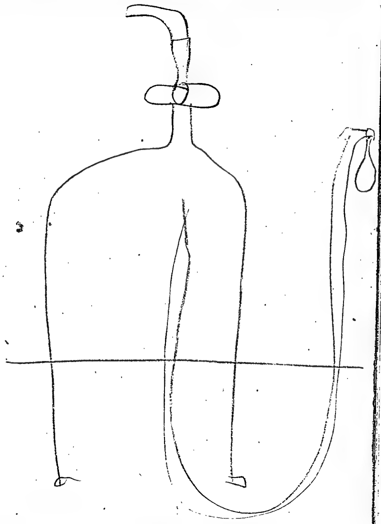


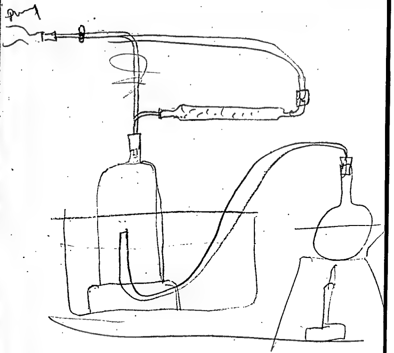


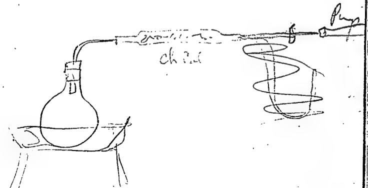


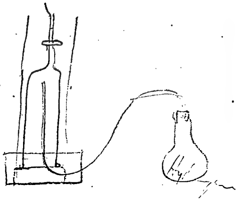


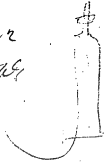




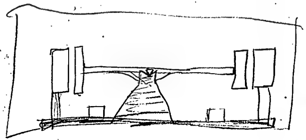


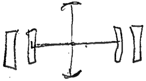

Pump

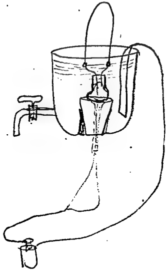




Aug 17 1882
TAE





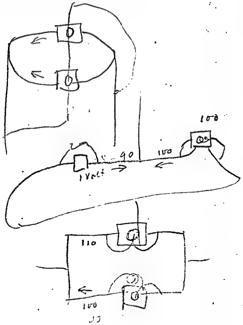


250

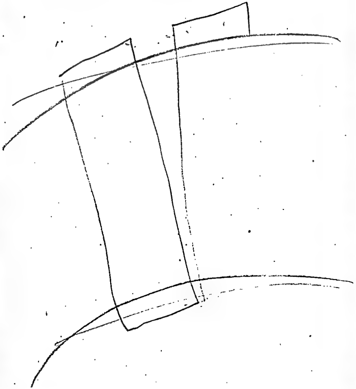
12100
44
48400
48400
532400

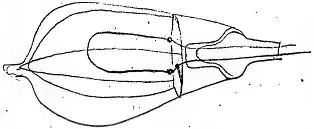
110
110
1100
110
12100

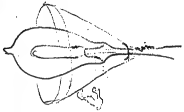
Aug 18 1882
TAE 2½

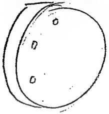


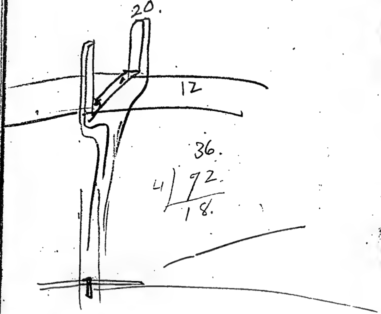
Aug 18 1882
TAE

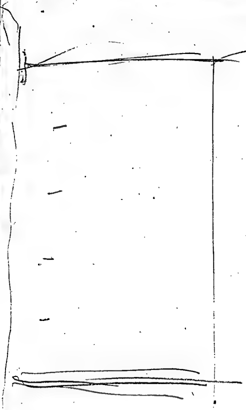




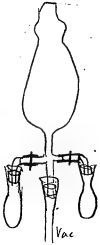


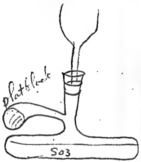


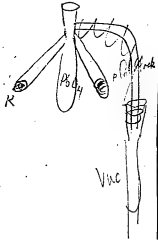

20.
12
36.
4)72.
18.



Aug 8 1882 TAE

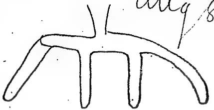


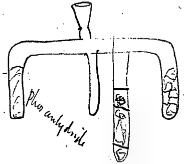


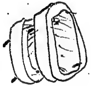


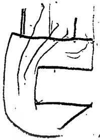
Aug 8 1882

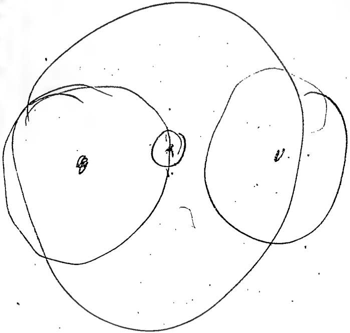
TAE

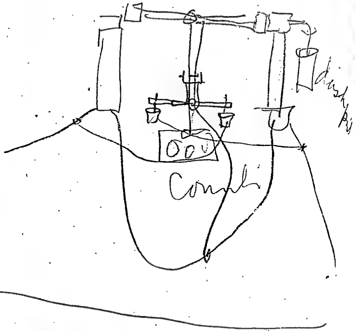


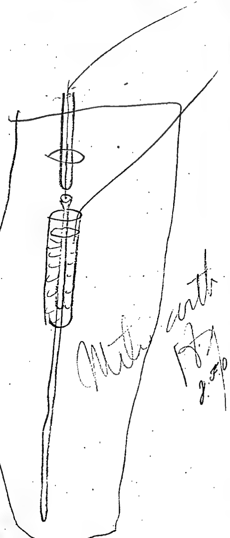






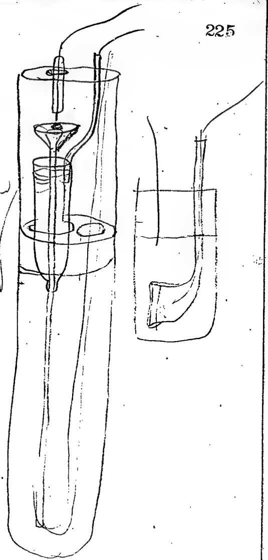






Mike with Hg.

J.F.O.

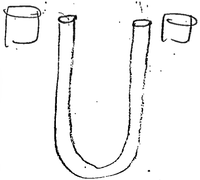


Mike with Hg

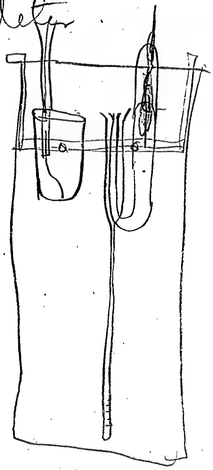
Jany 20 1883

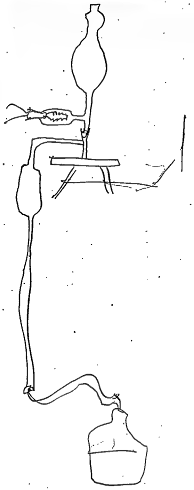
Tat

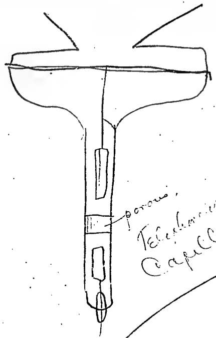
J.F.O



Meter







Telephone worked by Capillarity

January 20 1881

Edison

TAE

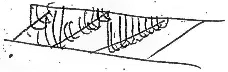
Absorbing HCl gas -

Gallo ox Zinc

" " Bismuth

Melted balls Sul Soda melted their own water cryst'n,

Phosphoric anhydride must be used as drier,



~~1350~~
8100
2500
7200
600
1000
500
500
300
1000
1000
1000
~~8500~~
31200

3000 / 31204 / 6

150 / 250.0 / 150 / 1000 / 900 / 16.

16.

150
13
450
150
1950

280
3
840.

35
3
75

10

16
8
128

140. / 840 / 840 / 6.

1.

1.

Menlo Park Notebook #210 [N-81-00-03]

This notebook is undated but was probably used in 1881 or 1882. It contains notes by Edison relating to the geology of various states. Most of the material was copied from published geological surveys and other published works. The label on the front cover is marked "Magnetite etc" and "Iron Sand." The book contains 280 numbered pages.

Blank pages not filmed: 62-280.

Missing page numbers: 3-8.

Magnetic pyrites }
" oxide of iron }

Geological Survey State of New York 1840

Page 58 Clinton Co.

"The magnetic Iron ores of this County
"are among the best in the state."
"The Arnold mine especially mentioned
"on account of quantity & quality."

Page 64 Essex County

"Enormous deposits of" magnetic iron
ore" which are found in various
"parts of the County."

Page 66. Franklin County

"Magnetic iron ores, specular iron ore
"and bog iron ore".

Page 69. Herkimer Co

"Vein is from two to eight feet wide and has been traced about three quarters of a mile highly magnetic and yields iron of good quality".
Magnetic iron ore.

Page 71 Jefferson County

"There is a valuable bed of magnetic ore in the southern part of the County."

Page 73 Lewis County

"Veins of magnetic iron ore are found in the primitive rocks on Moose and Black Rivers extent and value has not been determined"
"I have found magnetic iron sand on the banks of Moose River near Lyondale."

Same

Page 76 Monroe Co.

"In addition to this magnetic iron,
"sand has been found in considerable
"abundance on the shores of Lake
"Ontario"

Page 83 Orange Co

"The important mineral product
"of this County is magnetic iron
"ore of which there are vast beds.
"situated chiefly in the town of
"Monroe"

"A bed of magnetic iron ore has
"been recently opened near the village
"of Canterbury" good quality
local situation"!

Page 84 Putnam Co

"Contains several beds or veins of the
"magnetic kind, which yield ore of
"the best quality and in the greatest
"abundance"

Same

Page 83 Ontario Co

"Magnetic iron sand is found
"near Geneva". ✓

Page 93 St Lawrence Co

"The magnetic kind is found in
"several places and is of a good
quality"!

Page 100 Suffolk Co

"Magnetic iron sand and garnet
"sand are found along the whole
"sea shore".

Page 102 Warren Co.

"Of iron ore there are in Warren county
"numerous and important localities
"embracing both the magnetic oxide
"and the hematite"!

Same

Page 103 Washington Co.

"Iron ore both of the magnetic and
"hematitic kinds have been found
"in it."

Geological Explorations of the
40th Parallel - 1877.

Page 18 - Laramie Hills.

"As accessory minerals there occur
"magnetite, allanite" etc

Page 26. West side of Longs Peak

"Magnetite in small irregular
"particles was seen in a number of
"localities." ✓

Page 108 Birch & Cottonwood Creeks.

"The quartz is usually quite pure
"accompanied occasionally by fine
"particles of magnetite".

Same

Page 160 Park Range.

"As accessory minerals, garnet, magne-
"tite and gold."

Geological Survey of Indiana [illegible]

No minerals mentioned

Geological Reconnaissance in
California 1858

Page 50 Near Castica Lake
Cañon de las Uvas.

"I found a mass of black ore which
"attracts the needle strongly, and is
"probably ordinary magnetite or
"magnetic ore."

Page 289 Cañon de las Uvas

"Magnetic iron ore occurs in a
vein about three feet thick

Same.

Page 289 Williamson's pass

"Large Rolled masses of magnetite
"were picked up in the bed of one of the
"streams entering the Valley of Williamson's
"pass on the east side".

Explorations in Utah 1859

Page 269. Igneous Rocks

"Particles of specular or magnetic
"iron ore a frequent occurance
"in connection with the eruptive
"rocks of this district".

Page 323. Cedar City

"Superior magnetic iron ore occurs
"in the mountains near Cedar City".

Geology of California 60 to 64
Page. 189. Cañada de las Uvas
and Soledad Pass.
"Magnetic oxide of iron is also
"found in this vicinity".

Page 190. Base of the Canada de
las Uvas.
"ferruginous metamorphic rock,
"containing magnetic oxide of iron,

Geology of Arkansas 1857 & 58

Page 217 Independence Co. (Eastpart)

"Very rich in iron ore but too much
"mixed with sand to admit of
"its being used profitably".

Geological Survey of the Territories
1867, 1868 & 1869. Hayden - Colorado

Page 193 Colorado

"At the source of the Chugwater are
"immense deposits of magnetic
"iron ore in the metamorphic rocks".

Magnetic iron ore Las Vegas Metallic iron p.c. 20.43
" " " Placer Mountain " " 65.27

U.S. Geological & Geographical
Survey of Colorado and adjacent
Territories - 1876. Hayden.

Page 122. Colorado

"Iron is found and mined in
"Colorado on Grape Creek near
"Canyon City." The ore is magne-
"tite yielding a high percentage
"of the metal,"

Geological Survey of Montana
1872 Hayden -
Makes no mention of Magnetism

Geological Survey of Wyoming
1871 Hayden -
Page 112 -
"In the bed of the Clearwater, and
"on the sides of the adjacent hills
"we found immense numbers of
"rounded black nodules of mag-
"netic iron ore which seemed of
"unusual richness

Geological Survey of Ohio
Newbury 1870.
Page 45. North eastern Ohio
"And Black-Band - as in the
"Valley of the Little Beaver - is
"introduced as another element
"into this ferruginous belt".

Report of Statistics & Geology of
the State of Indiana. 1879 - 1875 -
1876, 78 - 1874 - 1873 - 1871 - 1869 - 1880
All refer to slight and small
deposits of iron in various sections
but no sands or Magnetite.

Geological Survey of N. Carolina
Kerr 1875
Page 217.
"The ores of iron are very widely dis-
tributed in this State, including

"Magnetite, Hematite, Limonite
"and Siderite"–

Page 219 Nash Co
"Ore is often in ~~large quantities~~
"quite large compact lumps of
"a reddish-brown color, and is
"slightly magnetic,"

Page 225 – five miles above the above
locality on farm of Mr Harris.
"here it is highly magnetic fine grained
"and dense – reported 3 or 4 feet
"thick".–

"In Granville Co. is an outcrop
"of coarse granular somewhat
"slaty magnetic ore".
"hand specimens of very coarsely
"crystaline magnetite of ten to
"fifteen pounds weight associated
"with syenite, are found within
" a mile of Raleigh".

Same

Page 223. Chatham & Orange Cos.
"About 1 mile North of the Buck-
"horn mine is a small vein about
"1 foot thick of a highly magnetic
"ore".—
Page 224 Chatham & Orange—
"Besides the localities already
"mentioned, a number of addition-
"al outcrops of ores have been
"noted mostly magnetic; one
" 2 miles North of Buckhorn (at Dewe's)
"yielding 57.77 per cent of iron and
" three or 4 others in a southwest
"direction, for 10 miles to the head
"waters of Little River—at McRee's
"Dalrymple's and Buchanan's")

Page 232. Chatham Co
"A fine quality of magnetic ore. dense,
metallic and very fine, is found on
the east side of Haw River and about

two miles distant at the foot of Terrells Mountain on the farm of Mr. Snipes"

Page 234 Orange Co.

"A magnetic ore makes its appear-
"ance about 20 miles northeast-
"ward, 3 miles beyond the upper
"forks of the Neuse River in the
Southeast corner of Orange County
on Knapp of Reeds creek on the
farm of Mr. Jas. Woods."

Geological Survey of Missouri
Swallow 1855

Page 133.

"At Shepherd Mountain the ore
"is usually a mixture of Specular
"and Magnetic Oxides (the
Magnetic being the least abundant)

Page 72 - 2 part

"The magnetic iron ore gives a
"black powder - for the manufacture
"of iron it is not inferior to any of
"the other ores, and is found at
"Shepherd Mount intermixed with
"Specular iron"

Geological Survey of Missouri
by Broadhead - 1873-4

Page 176 Bates County

"On the slopes of Sand Mound at the County line and also north of Rockville are exposures of Hematite ore of light specific gravity but it is often too silicious."

Page 255 Adair County.

"On the Chariton River two miles north of the south County line numerous masses of Septaria are washed out of the prairie and strewn along the river banks, - studded with Limonite, - The "Limonite globules vary in size from a pin point to that of one sixteenth of an inch."

Pages 646 to 661 describe the various distribution of drifted deposits of Limonite iron ore banks of the State most of the ores being porous, cherty or sandy, but makes no mention of Magnetic ores

Geological Survey of Missouri
1853–73 Pumpelly

Gives sketches of iron [illegible] [illegible] Counties. Ores classed [illegible] as [illegible] Hematite – No Magnetic ores or sands mentioned,

Geological Survey of Missouri by Pumpelly in the [illegible] 1873
Pages 196–214 – list of [illegible] locations [illegible] etc,
"Shepherd Mountain Iron Co. [illegible]
"[illegible] bank Iron Co. Magnetic [illegible]
Are the only mentions of Magnetic ores

Exploration & Surveys west of the 100 Meridian – Wheeler 1875 [illegible]

Page 261–
An excellent quality of Magnetite is found near Iron City – in Southwestern Utah – very easy of access and [illegible]

"quantities practically inexhaustible"

Page 570 - Chiricahui Mountains
In the vicinity of [illegible] Gallegas
they contain magnetic ore probably in quantity to give it economic value."

Explorations [illegible] from the Mississippi River to the [illegible]
1853 to 1856

Entirely Zoological

Natural History of New York
Mineralogy - Lewis C. Beck, 1842
Page 392 - Localities of Magnetic Iron Pyrites -
Essex County 1½ miles north of Port Henry on Property of C. Stone strongly attracted by the magnet -

"Lewis County, associated with magnetic iron ore at the O'Neil mine, the Rich Iron Mine, near Greenwood furnace, and in other parts of the town of Monroe."

In Connecticut, the crystallized variety of magnetic iron pyrites occurs at Monroe and in Trumbull

Page 22. Magnetic Iron Sand whole coast of Long Island. — on the banks of the Hudson near West Point and on the banks of many of the streams of the Highlands. — It occurs in great abundance at Port Henry and elsewhere on Lake Champlain — on the shores of Lake Ontario in Monroe Co and on those of Geneva Lake and Lake Erie

And on the banks of Moro
River at "Lyndale" in Lewis Co.

Mineralogy. Dana, 1868
Page 151 Magnetite
"In North America it constitutes
"vast beds in the Azoic, in the
Adirondack region Warren, Essex,
and Clinton Cos in Northern New
York while in St Lawrence Co
the iron ore is mainly hematite!
Also similarly in Canada, in
Hull, Sherbrooke, Madoc etc. and
at Cornwall in Pennsylvania
And at Magnet-Cove Arkansas
It also occurs in N York in
Saratoga, Herkimer, Orange and
Putnam Cos; at O'Neils mine,
Orange Co., in Crystals

In Maine, Raymond, Davis Hill. in an epidotic rock; at Marshall's Island. masses, strongly magnetic. — In New Hampshire, at Franconia, in epidote and quartz; at Swanzey near Keene, and Unity — In Vermont at Marlboro; Rochester, Bethel and Bridgewater, in crystals in chlorite slate. — In Conn. at Haddam (Haddam) in crystals — In New Jersey at Hamburg near Franklin Furnace — In Penn., at Goshen, Chester Co.; at Webbs Mine, Columbia Co.; in dendritic delineations forming hexagonal figures, in mica at Pennsbury and New Providence — In Maryland at Deer Creek — In California in Sierra Co. abundant

Massive and in crystals: In Plumas Co.; Mariposa Co.; east of the Mariposa estate, on the trail to the Yosemite; Placer Co., Mts. ranch; Los Angeles Co., at Cañada de las Uvas; El Dorado Co., near the Boston Copper Mine in rock. And at the El Dorado Excelsior copper mine. — In Canada at Sutton in crystals; Bromley, etc. — In N. Scotia, Digby Co., Nichols Mt. in fine crystals;

Page 59 Magnetic pyrites

In Vermont at Strafford, Corinth and Shrewsbury. — In many parts of Massachusetts — In Conn. in Trumbull with topaz, in Monroe and elsewhere; in New York 1½ miles north ~~east~~ of Port Henry, Essex Co.; near

"Natural Bridge in Diana Lewis
Co; at O'Neills mine and else-
where in Orange Co. — In New
Jersey Morris Co. at Hurdstown.
cleavable massive. — In Penna.
at the Gap mines Lancaster Co.
Niccoliferous, — In Tennessee at
Ducktown mines abundant. —
In Canada in large veins at
St Jerome etc."

Page 800 Magnetite

"A niccoliferous Magnetite
occurs (according to Peterson)
north of Pregratten in the east-
ern Alps."

Agriculture and Geology of Maine 1862

Page 421 Magnetite
Specimens of a superior ore from Union were placed in my hands for analysis — Remarkable purity proportion of iron 64.

Page 422 Black Sand (Ore)
Where the Canada road crosses this belt in Sandy bay the vein looks exceedingly promising and the banks of the streams are full of the black sands.

Page 372 Magnetic Iron
"In the north western section of Linneus, iron ore is found combined with the slate — Specimens were obtained that were strongly magnetic."

The Iron Region
Foster and Whitney 1857
Page 18. Michigan - Southward
from Teal Lake -
"Chlorite slates and vast Masses of
specular and Magnetic oxide of
iron"

Page 22 - "On the north side of Machi-
-gummi in numerous places, Mag-
"netic iron is seen associated with
hornblende or quartz"

Also in various other places
in the Lake Superior Regions -

Geology of Massachusetts -
1833 Hitchcock -
Page 230 - Iron sand
"Bushels of this substance may
sometimes be collected on the
Montague shore of Connecticut River

40 rods below Turner's Falls

Geology of Vermont (Adams) 1845

Page 23 - "Iron sand in the soil of talcose slate regions".

Page 217 "Magnetic Iron ore in the form of iron sand in considerable quantities occur in the sand beach next north of Clay point," Waterford Co(?)

Geology of Wisconsin 1873/77
Vol. 2.

Page 239.

Magnetic iron sand popularly known as black sands on the entire shores of the lake - (Probably lake Michigan)

Geology of Massachusetts 1841
No Mention of sands

American Cyclopedia
Page 407. Vol. IX
"Lake Superior Ore beds were once all Magnetite in composition and have been changed to sesquioxide by the addition of oxygen,
"All the Missouri specular iron is more or less Magnetic!"
Same page 409. Magnetite
"Vast beds in the azoic of the Adirondack region, Warren, Essex, and Clinton Cos, in Northern New York —

In Morris, Sussex, Warren, and Passaic Co. N. J. — Cornwall in Lebanon Co. Penn. — at Hull, Grenville, Madoc, &c. in Canada — Greensboro North Carolina. — Large deposits in Sierra Co. Cal. — and in Oregon.

Menlo Park Notebook #212 N-81-05-23]

This notebook covers the period May 1881. Most of the entries are by Charles Batchelor. There are also a few entries by Edison and John Ott. The book consists of notes and drawings of items to be sent to the Electrical Exhibition in Paris. Several loose pages, attached to page 133, contain notes relating to a contract between the Edison Lamp Company and the Edison Electric Light Company of Europe, Ltd. The label on the front cover is marked "Orders for E. E. at Paris in 1881." The book contains 280 numbered pages.

Blank pages not filmed: 188-215, 230-231, 238-275.

Missing page numbers: 25-26.

xE172 N-81·05·23

Exhibition May-23 1881 1

People who go—

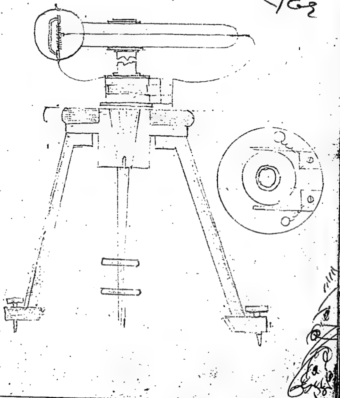
1 Kinney
2 Kinneys Boy
3 Dr Moses
4 Suebel
5 Atchison
6 Onnis
7 Hammer
8 Hipple
Force

Instruments to exhibit =

1 Thermo Galvanometer with Mirror in Vacuo

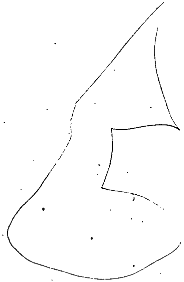
2

May 23 1881
TAE



2

Air engine with platinum spiral in Cylinders



3 Bamboo Samples and all
other fibre samples

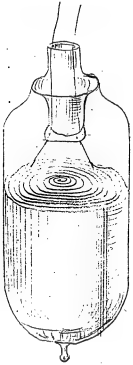
4
2 Copper Calorimeters for testing lamps -

Never ending Clockwork —
Davis is making clock
see him

May 23 1881

TAE

6 Mica condenser in Vacuo



May 23 1891

Tesla

Made working drawing J.F.O.H.

7 Chalk Battery

May 23 1881

TAE

8 Agar lighter to be worked on the system

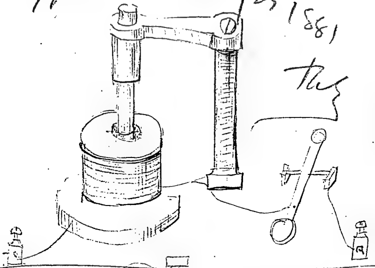
May 23 1889

Tas

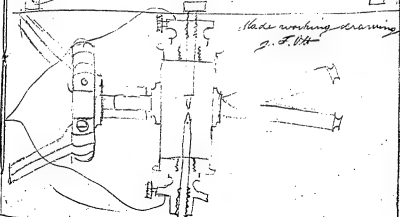
9 Electric pen (3) three
10 Also one "Gramme" pens
2 Reed pens
2 Presses
1 Automatic Presses from
S. Morse.

May 23 1881

10 Etherscope and Etheric apparatus May 23 1881

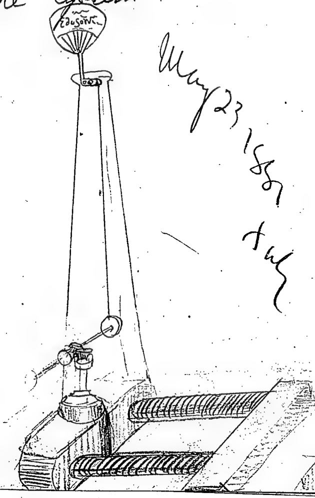


TAE



Made working drawing J. F. Ott

11 Electric fan to work on the system



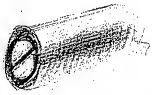
May 23 1887

Tuly

13 Motographie Galvanomet

14 Inertia Telephone

15 Samples of all street connection boxes all house boxes and street mains from Kruesi —



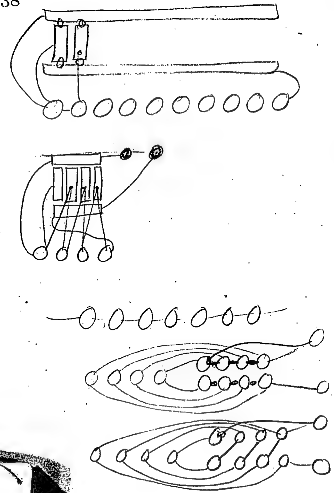
May 23, 1881

TAE

16 12 Platinum spiral
lamps $\frac{1}{1000}$ 20/
high vacuum

17 6 Pt spiral lamps
Thermo regulators

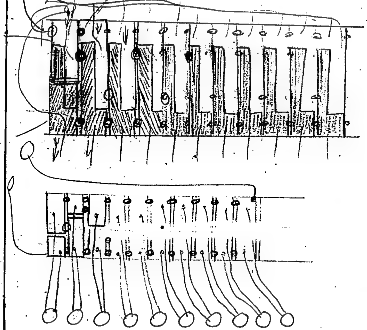
6 Turn down lamps



19 Resistances —

~~[illegible]~~ with

lamp resistances



May 28 1881

Chas Batchelor

TAE

20

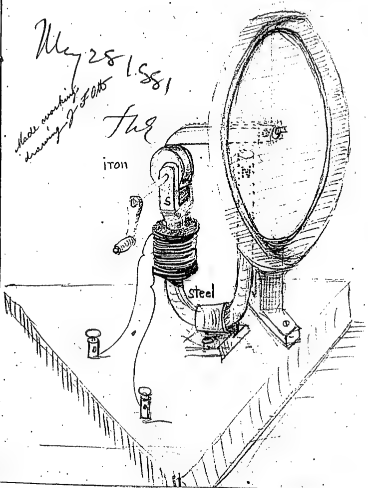
2 Sets of Leyden jars
in high vacuo 6in
set lamp size

21 / Magnetic Motograph

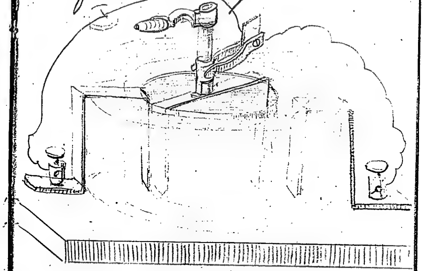
May 28 1881

Made working drawing of J F Ott

The



1 Current Regulator
fluid 'Budge'



Made working drawing J. F. Ott

May 28 1881

TAE

1 Hand ship Motograph
for illust: principle

24

Sample every kind of telephone = at least 30 kinds from his Caveat

25

1 Photometer for use there
in good style

26

1 Electric piano

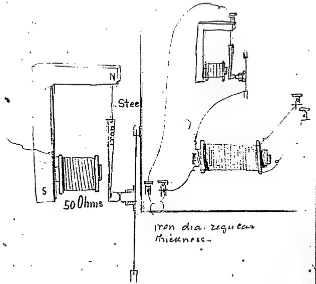
May 28 1881

Tay

27

1 Electric pump by
Sewing machine motor

1 Telephone repeater

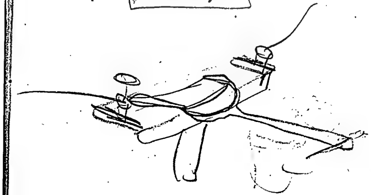


May 28 1881

Made working drawing J. F. Ott

TAE

1 Relay worked by cutting in & out of Carbon strip



made working drawing J. F. Ott

May 28 1881

TAE

30 Signalling by Thallium line in Spectroscope

May 28 1881

TAE

Lasimeter

Horoscope -

33

Small induction Coil
in Vacuo terminals inside

May 28 1881

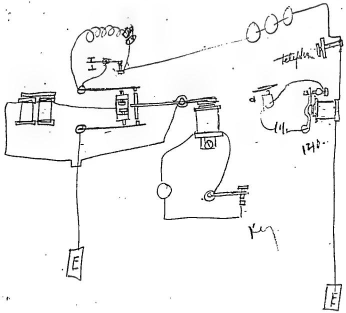
TAE

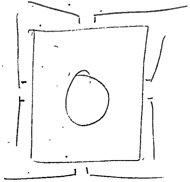
Vibrating puncher

35

Pneumatic pen

Duplex of patent
217.782





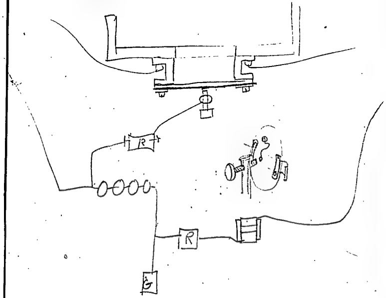
659

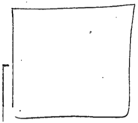
Working model of Pat.

203 014

Can make at Menlo
Page 662

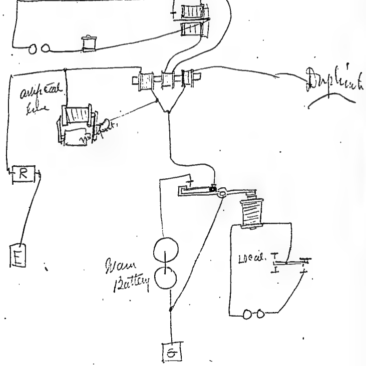
Ed. Pat-





Dupex of patent

178221



39

2 Gold and Stock Thinkers

hand transmitter —

Key and shelves etc-

Roman letter perforator
Evans and Lee with extra
pens.

4 Morse Automatic –
1 Paper wetter
~~Crock~~
Tin Case of 100 lbs yellow paper
250 lbs. Receiving paper
500 lbs Perforating paper
1 Morse perforator
2 Automatic insts, table + Crank
~~Sef~~ Self paper winder
Clockworks for copying
Extra pens
3 Tel. pens
24 Automatic Students

2 Universal printers

2 American telephones
Combinations

2 English Telephone
Photographs

1 Pressure Relay with
Sounder and Key.

1 Motograph Relay
with Key

2 3 Key perforators

/ Carbon Rheostat

/ Musical Sel. only

2 Fac-simile's

1 Phonomotor —

52

1 American District.

1 Domestic Instruments
with recorder _

53

1 Phonograph arranged
to be talked to by
Motograph

Photographs of 65 5th Ave
Goercks Street shop
Lamp Factory
at Menlo
Laboratory at Menlo
Also Peters Wks
"Graphic" picture of
electric Railroad with
date on it

55

~~Pt~~ Patents

6 Sets of my U.S. patents bound

2 Bound Copies of all Eng patents to date -

2 Bound Copies of all Eng patents relating to Elec. Light

26 Copies Photo Lith. of French Patents on "Light" to date

SO

Scrapbook of publications
relating to Elec Light
especially Herald Dec
21 1879 and all about
then and few months later
Phila. Ledger - Steamship Col

4 Cells Callaud battery
Copper above blue vitriol

Drawings of Electric Buoy

Working models of all
different transmitters
Shewn in Page 111 Vol 5
Exper Researches

p 171 Vol 5

p 175 - Vol 4

Sewing Machine Motor
& machine

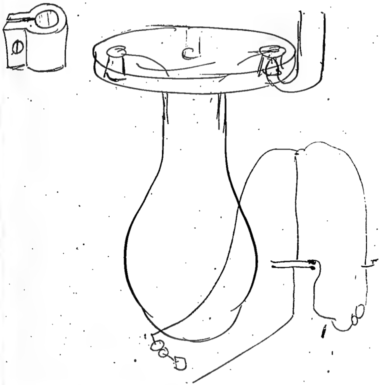
5 HP Motor

62

1 Dynamo $\frac{9}{1000}$ for Com-
petition test.

63

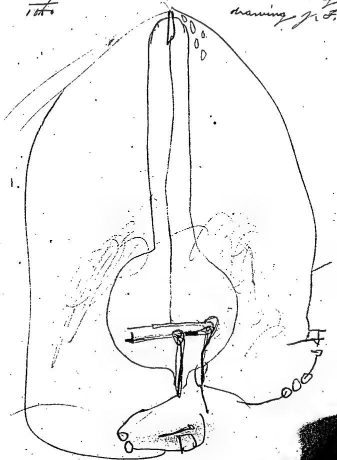
1 Case of Graphite sheets
and loops from them



1 Expansion Relay

7/10th

Made working drawing J. F. Ott



1 Kerosene lamp with a
little Blowed ('Electric')

Lamps

Get Uptons order for Paris
given him by Edison

[ITEM FOUND IN BOOK]

Edison Lamp Co –

You will proceed to make for the Edison Electric Light Co of Europe Limited 5000 A Lamps, not less than 100 ohms and with an economy of 10 per Electrical horse power – and not to vary more than 2 Volts = ~~Have Lamps~~ also 2000, 8 candle A Lamps, – and 2000 8 candle B. Lamps, + 500, 16 candle B lamps

The 8 candle A Lamps, to work on the same Volt + circuit as the A 16 candle Lamps – + not to vary ~~any more~~ more than 2 Volts to have an economy of 20 per Electrical hp.

The B Lamps to be worked on the same circuit as well,

~~You will at~~

~~Also~~ ~~also~~ a few of the B Lamps should be put in very small globes =

2

about 25 4 candle lamps should be made that they can be worked with a battery =

3

You will also furnish 4 lamps with a Crown of Carbons A size. with 4 inside parts sealed in one large globe all carbons in Multiple arc – and any other nice thing you think would be interesting at Paris

charge the same to the E E L G of E. proudt

[ITEM FOUND IN BOOK]

1881

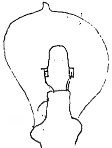
E. L. Co

Copy Contracts
for England
& Paris

3 A Lamps E L Co want order

= =

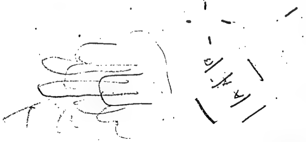
Continued



Worked by Battery
very small surface

E L Co - making - Fibres cut
have to put them
in straight.

= =



TAE May 28 1881

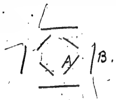
TAE TAE

67 Samples of Carbonizing Paper - Wood etc

New nonmagnetic Dynamo

69 ~~[illegible]~~

Crown Lamps



C.L. Co want order

70
Lamps

71 2 Lamps
8 B lamps all in one globe
in Multiple arc
E. L. Co want order

Graphite Carbons

E L Co got them
want order

73

1 Vote Recorder

74

1 E.M.F regulator
for Main System

75 /

Beam Meter –

76

12 Regular Meters

77
1 Mirror Weber Meter

1 Quadruplex-get

79 Chandeliers

Spring brackets.
Brackets
Globes
Shades.
Safety catches.
Cleats.
Wire appliances.
Wire
Tools.
~~Cut~~ Switches.
Drop lamps.
Flexible cord.
~~Mining Lamps~~.
Detachable Chandeliers

80

1 Magnetic Ore
Separator —

1 Steam Dynamo
and appliances

82

Lamp stands cales
~~and lamps~~

83

High Vacuo tubes

84.

1 Lamp with Mercury Columns

$\frac{1}{8}$ Bissed 6" long Bamboo

6 Ground stopper lamps
E.L. Co = making now

6 Iron wire lamps

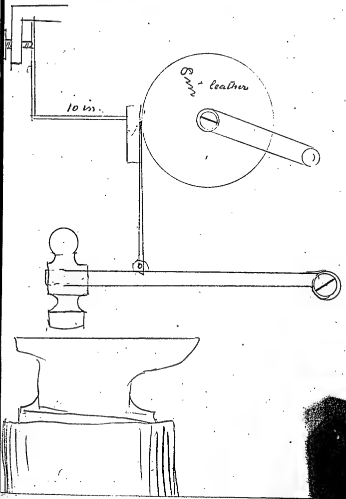
6 Nickel wire Camps

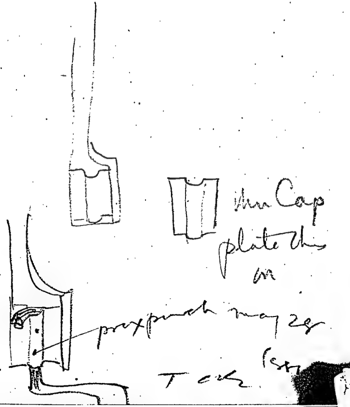
Certified Copies of the patents on telephone to show the Judges as to dates when talking over the Carbon button and microphone

89 Johnson's Clockwork Motograph

Switch board as
per Johnson's order—

Motographic trip hammer




Inn Cap
plate this
on
prexpunch may 2g
less
T edge

In telephone department

I want:—

~~1 Inertia telephone~~

{Every kind of telephone from caveat

~~Telephone Repeater~~

2 American telephone combination

2 English telephone motographs

1 Musical telephone outfit

1 Phonographic telephone

{Transmitter from Vol 5 Exp Cen.
Pages 111 171
Vol 4 175 p.

~~Johnson Clock~~work motograph

~~South bound~~

Lamps we want

6 Spiral Pt lamp 17

~~17 18~~

6 turn down Lamps 18

66

Bergman is making

May 25th

200 3 Light Chan. of which 5 detachable a few with Globes

100 2/5 " detachable "

50 1 "

50 Swing arms

25 double joint

25 single

100 Rigid brackets with cocks or sockets

6 Desk lights

4 5 light Chandeliers with 1 Drop light a centre

1000 Shades

250 Ornamental Safety Catch

500 plain wood

1000 ~~[illegible]~~ cut off " with Plugs

Cleats

Wire

Double pointed tacks

Lead wire

100 ~~Sockets~~ Extra Sockets

Screws for Cleats etc
flexible Cords

Expt. Tools { Pliers
Solder iron
hammers

Switches 25 No 1
12 No 2
5 No 3

Sewing mach motor and
S. M.

Bergman ~~finished in few days~~
finished 8th June

~~[illegible]~~
EM + Reg - Main System
Berg. made
Goerck St

Mirror Tele
~~Berg~~ Adaster
Berg. 1st June will be ready

Lasimeter ~~Electrical~~ no appliance
Berg done

Beam Meter
Send to Bergman

Carbon Rheostat
done Bergman

Stock Quotation &c
Berg ~~[illegible]~~ June 2
will

---

2 Private line Universal
Berg 10th June

Kinney Inst
Bergman ~~[illegible]~~ See Kinney

~~Domestic Inst~~
~~Berg [illegible]~~
~~Schall [illegible] to get Recorder~~
~~to Bergman [illegible]~~

~~[illegible]~~

~~Relay [illegible] out [illegible]~~

---

3 Duplexes get order for
Bergman

~~Pressure Relay with Relay Key~~
~~Bergman finished~~

~~Motograph dito ditto~~

Automatic 1 Perf 2 Key Perf Done Complete Mng.
Bergman ~~###~~ June 5th

Perforator finished

Roman Letter Automatic
Perforator done
rcd 10th June

~~2 3 Key Perf~~
~~Berg~~

~~Tel Com Auxil.~~
~~B. done~~

~~Eng tele~~
~~B done~~

~~Inertia Telephone~~
~~Berg Sent one to B~~

~~Musical " outfit~~
~~Berg - 8 ~~##~~ June~~

~~Phono Tel. outfit~~
~~Berg. 1st July—~~

~~Clockwork Moto~~
~~B. 1st June —~~

~~Switchboard~~
~~B 10th June~~

~~Cigar lighter~~
~~get drawing for Berg~~

~~Kerosene Lamp~~
~~B— got deliv. May 26~~

~~Vote Recorder~~
~~Berg Edison gave sketch~~

~~Hand strip Motor~~
~~B— finished.~~

Laboratory is making

~~Platinum spirals~~ h

Turn up air down lamps

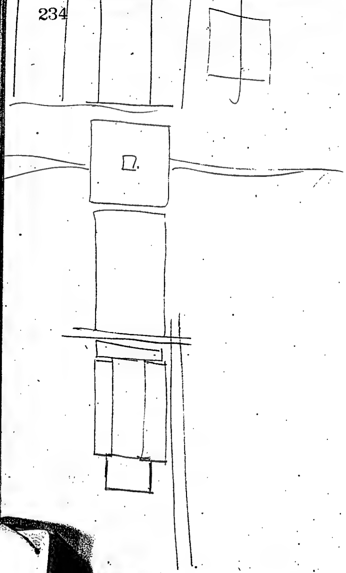
Chalk battery

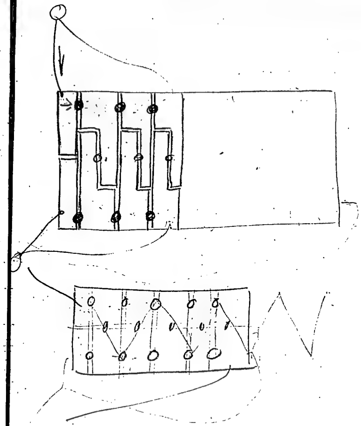
Platinum spiral regulator lamps -

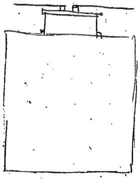
Etheric apparatus

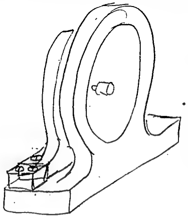
Thermoscope

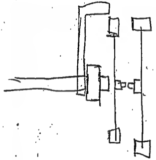
Da

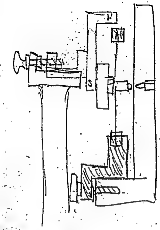






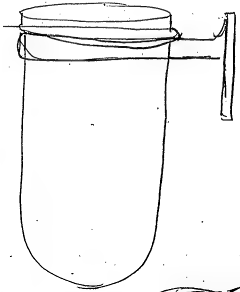


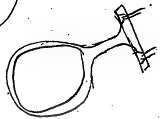




280

Bergman for Pump Motor
Fan Motor





Menlo Park Notebook #213 [N-81-05-14]

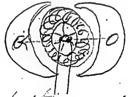
This notebook covers the period May 1881. The entries are by Charles P. Mott. The book contains the results of a search for literature about magnetic lines of force and their relationship to the setting of commutator brushes. The label on the front cover is marked "Lines of Magnetization," "Dynamos," and "C.P. Mott May 14, 81." The book contains 280 numbered pages.

Blank pages not filmed: 120-271, 274-279.

Missing page numbers: 5-6.

From Mr. Edison May 14 1881 1

"All Articles with page and date describing any Magneto mach & duplicates"



"Find out the exact words all writers use in describing how to set the commutator brushes = "Line of Magnetization"

"Commutators set at right angles to the line of Magnetization"

Pages 77 to 126 inclusive describe Machines of Pixii, Clarke, Breguet, Brush, Wallace Farmer, Siemens, "Alliance" Holmes, Wilde, Ladd, Trouve, Rapieff, Gramme, Edison, De Meriten, & Lontin.

Page 80 Brush

"When the section of wire is passing
"the neutral point on the armature
"the plates are in contact with
"the insulating material of the
"cylinder between the corresponding
"segments, thus cutting the section,
"which is at the time useless, out
"of the circuit altogether,"

Page 82 (Siemens & Gramme)

"The plates press upon the cylinder
"in this case at points corresponding

"to the neutral point of the armature
"thus being at right angles with
"their position in the first arrange-
"ment."

Page 99.
"Mr Gramme collects the currents
"developed in the ring of his machine
"by establishing collectors on the
"line where the currents in contrary
"direction encounter each other."—
"The friction brushes on the pieces-
"are in a plane perpendicular to
"the polar line, that is at the middle
"or neutral point."

Page 121- Lontin Machine
"A metal strip is placed opposite
"the pole of the electro magnet to
"collect by contact the electricity
"generated in the coil at the instant
"that its polarity becomes reversed"!

Higgs

Page 126 - Gramme "Distributor"

"The current from the small machine
"is led to the rotating magnets through
"the flat brushes of silvered copper
"wire attached to the frame work of
"the machine, and in rubbing contact
"with two insulated copper cylinders,
"one connected to each end of the
"magnet circuit."

Noad - Preece

Describes machines of Sexton, Holmes "Alliance" Wilde, Siemens, Ladd Tisley, Gramme.

Page 337 Siemens,

"The currents so generated are collected
"on two metal rollers, or brushes, so
"that at two points, diametrically
"opposite the single sectors pass
"under the rollers or brushes with
"elastic pressure giving up to them
"their electrical charge".

Page 339 Gramme

"The tails of the radius bars are all
"grouped together round the central
"axis and they are rubbed against
"by suitable collectors, which take
"up the electricity".

Pages 13 to 27 inclusive describes Machines of Holmes-Alliance, De Meritens, Siemens Gramme, Wilde, Wallace-Farmer, Brush, Lontin

Page 14. Holmes Alliance

"The positive ones currents being collected "on the axis of the machine: while a "concentric, but insulated cylinder "is used for the negative ones".

Page 15 De Meritens.

"No commutator or collector is required "with the machine."

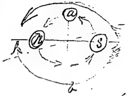
Page 19 Siemens

"Two brushes, tangent to a circular "commutator, placed on the induction "coil shaft carry off the electricity "in one continuous direction."

Sprague - 1875

Pages 328 to 340 describes machines of Gramme, Ladd, Marcus, Siemens Wilde.

Page 329



"a, helix resting on neutral line a, b, of the magnetic poles N. S. - line of motion from a to n -

"By means of a commutator on the line "N. S. - a current can be obtained in "one direction, though not continuous", - - 'The point of change is not practically "on the line N. S. but in a line in "advance of it as shown by the dotted -"line" —— The position dependent upon "the quality of iron of the armature and upon the rate of rotation."

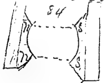
Page 330 - Siemens

" Springs - fitted with a turned pad "of steel or other metal, press upon "the cylinder and take up the current."

Sprague

Page 334. "Grammes"

"In the machine itself these springs are
"replaced by brushes of wire thick enough
"to press on, at least two contact pieces."

Page 337.  Gramme

"We may also regard the space between
"the dotted lines of fig. 84. as a single
"magnetic field."

Page 55 Brush Machine

"The outer ends of all the coils are
"brought through the shaft of the
"machine and are connected to corres-
"ponding portions of the commutator,
"where the currents are collected by
"suitably placed copper plates or brushes".

Page 1 Jany 2, 1880. Dynamo Electric
Machines (generally) Editorial on recent
publications of Antoine Breguet,
"He is thus enabled to explain a point
"hitherto supposed irreconcilable with
"theory, namely, the practice of electrical
"engineers in setting the "brushes" or collec-
"tors of the current in the dynamo
"electric machines in an oblique
"position against the commutator,
"and unsymmetrical with respect to
"the field magnets of the instrument".
"He not only explains this but points

Engineering Jan 2.80

"out that it is an absolute necessity
"of the case, and that upon this position
"will depend whether the machine is
"better suited to be a generator or an
"electro motor." ——

"Faraday first recognized the significance
"of the so called lines of magnetic force
"which are seen crossing in curves through
"every magnetic field when iron filings
"are sprinkled over it" ——

"Faraday laid down the following
"properties as those possessed by these
"lines of force: Firstly, the lines of force
"tend to shorten themselves, Secondly lines
"of force lying in the same direction side
"by side repel one another, To these
"M Breguet adds that a line of force
"when it passes through iron or other
"metal capable of magnetic susceptibility
"must be regarded as if shorter than
"one of equal actual length passing
"through air."

Page 13. Commercial description of Brush.

Jany 9. 80

Page 37. "Heraldes" description of Edisons -

Feby 6. 80 Breguet

Page 116. description of Siemens - also touches Edisons as outwardly a Siemens Armature —

— The sectorial mercury cups are judic-"iously placed so that their edge of just "contact lies along - which we may call "the "diameter of commutation," at right "angles to the line joining the magnet "poles." - (Mercury cups act as brushes)

Feby 13. 80 Breguet

Page 136. Gramme.

"An arm carrying a wire brush serves to "place in communication the coils of the "moving electro-magnets, with the exciting "circuit; The current is collected and "transmitted by small brushes of silvered "copper wire." The brushes are moved by "means of a small endless screw."

Page 154. Breguet
"The magnetic force is concentrated
"into that part of the field immediately
"opposite the poles" (diagram shows
the most numerous lines between the blocks
marked N. & S.)

Page 155 Breguet
"To obtain the best possible results it is
"necessary to adjust the brushes which
"take the current from the commutator
"to an oblique position, different from
"that dictated by theory".

Page 228 - Mch 19. 1880 - Siemens
Historical description of Dynamos, of Siemens
Page 424 May 28. 80 Hopkinson
Electromotive force experiments, Resistance etc.

Page 63 July 25. 1879 (Generally)
In description of Gramme-
"The lines of Magnetic force within the ring
"are maintained parallel in direction
"to the convolutions of the iron wire and therefore
"with the annular axis of the ring"

Page 63 July 25, 1879 Gramme
"The opposite ends of these conductors
"are metallically connected to as many
"insulated copper strips arranged side
"by side around a circle, so as to form
"sectors of what is called the commutator
"cylinder upon which the metallic collecting
"brushes are pressed by means of springs
"and screws. These brushes are composed
"of hard copper wire electro plated with
"silver, and their object, by forming a
"rubbing contact between the internal and
"the external circuit of the ring is to offer
"a passage for the current induced in
"the coils of the armature so as to enable
"them to be used for doing external work".
— Such a ring is rotated in its own
"plane in a magnetic field produced
"by two opposite magnetic poles diamet-
"rically opposed to one another," —
"By placing collecting conductors in
"suitable positions, the two opposing branches
"of the current unite and flow out together
"forming an external current of their combined
"strength. —

Engineering

Page 63 July 25. 1879 (Gramme Mch.

"Two magnets having their dissimilar "poles opposed to one another, and "producing a magnetic field between "them, within which is rotated a "ring" etc —

"The effect however of rotating the ring "is to cause each point in succession "around the ring to be brought under the "inductive influence of the magnets, which "has precisely the same effect as if waves "of magnetic force were constantly travel-"ling round the ring in the reverse "direction to that in which the ring "is turning." — "Important action is "taking place between the lines of force "within the magnetic field and the con-"volutions of the coils of the induction "ring". — "As the lines of force consti-"tuting the magnetic field of the two "magnets form a series of elliptic arcs "joining their two poles."

Page 70 (Siemens) Upton on efficiency test of Siemens machine made by John Hopkinson.

Page 372 Nov. 14. 1879.
Describes DeMeritens Magneto-electric Mach.

Page 173 Aug 29. 79
Describes Gordon Machine
"Against the surface of this commutator
"collectors are pressed by means of springs,
"the one taking off the positive current
"and the other the negative."

Page 101 Aug 8. 1879
Describes Siemens machine
"Part of a closed electrical circuit is caused
"to move within a magnetic field so as to
"cut through the lines of magnetic force,
"in a path more or less perpendicular
"to their direction;"

Engineering

Page 102 Aug 8.1879

"The currents are collected by conducting
"brushes pressing against the commutator
" as it revolves." — "The collecting brushes
" are so placed with regard to it (commuta)
"that they take off the current generated by
"the machine at the position of maximum
" effect — that position gives the least
"sparks at the commutator" and in-
dicates "the machine is working at its
"greatest efficiency." —
"There is to every machine of this construc-
"tion one position for the brushes to
"bear upon the commutator in which
"the current is strongest, and where
"sparking is reduced to a minimum"

Jan 24.79 Page 75.- Gramme -
Historical discourse on Machines
generally -

Engineering

Page 309 April 11, 1879
Describes Wallace Farmer Werdermann? system
"The commutators are each pressed, above
"and below, by a pair of metallic brushes
"to lead away the currents that have
"been generated in the armature,"

Page 403 May 9.79
Efficiency test of Siemens machine
made by Hopkinson—

Page 513 June 20. 1879
General article and description of
mechanical generators—

Page 63 July 26. 1878 = (Hochhausen? System)
Describes the Gramme Machine.
"The current is led to the rotating magnets
"through flat brushes composed of silvered
"copper wire, fixed to the frame work of
"the machine and rubbing against two
"insulated drums or cylinders of copper,
"the first being connected to one end of the magnet
"circuit and the second to the other".

Page 391 Nov-15-1878

— Electro dynamic illustration —

"If an opposite pole be substituted for
"that of similar polarity, attraction will
"take place which will be illustrated by
"the running together of the lines of force
"radiating from both magnets, so as to
"form between them a bundle of elliptic
"loops connecting the one pole with the
"other."

Page 362 Nov. 1, 1878

"They produced currents of considerable in-
"tensity all of which were collected in the
"circumference of a circular disc, ~~called~~ termed
"a commutator, the currents ~~found~~ circu-
"lating on one half of its circumference
"being opposite in magnetic direction
"to those upon the other half," a separate
"contact brush serving to carry off
"the current from each half."

Engineering

Page 364 Nov. 1, 1878 –
Schellbach – Siemens Machine,
"Two brushes tangent to a circular commu-
"tator placed on the induction coil shaft
"carry off the electricity in one continuous
"direction".

Page 526 June 28, 78.
Power etc description of Siemens Machine by
Fontaine,

Page 63 Jany 25, 78
Dimensions & Powers of Siemens Machine"
Higgs

Page 88. Feby 1, 78
Historical description of Dynamos,

Page 49. Jany 18, 1878
Mechanical description of Gramme's Machine
"A metal strip or rubber is placed opposite
"this pole of the electro-magnet to collect
"by contact the electricity generated
"in the bobbin at the instant that
"its polarity becomes reversed." "a
"similar rubber being applied to the other pole etc.

Page 333 Oct 26. 77.
Douglass's Report to Trinity board,
on experiments conducted with various
systems of electric lighting.
Page 303 Oct 19.77
Tyndall's report on same experiments
each contain, comparative tests of
machines of Holmes, Alliance, Gramme
and Siemens — ec

Page 184 Sept 1. 1876 - Describes nicely
Breguet's machine —
"Twelve strips of copper are disposed radially
"And to them are attached the two adjacent
"ends of every pair of bobbins. The metallic
"springs are virtually current collectors,
"And as they are always in contact with
"several of the radial strips they must
"always be traversed by electric currents.

Page 418- May 19. 76. "Alliance"
"At each revolution of the machine each
"core has its magnetization reversed
"sixteen times, being magnetized 8
"times in one direction and eight
"times in the opposite".

Page 393 Nov. 19. 1875 - Tisleys Mach
"A rubber-spring comes in contact with
"the quarter of the middle ring and is
"connected with the electro-magnet of
"the machine and with the armature.
"Care is taken that contact shall be
"effected at the moment when the best
"magnetizing current is developed. A
"second rubber-spring is connected with
"the wire of the armature during the
"other three fourths of the revolution and
"this again communicates with any
"apparatus through which it may
"be desired to pass the current."

Engineering
Page 413 Nov. 27, 1874
Description of Gramme Mach.
"It shows several segments of covered wire
"with the free ends projecting from the
"ring. These are attached to copper
"strips which in turn are in electrical
"communication with copper sectors
"fixed on the spindle of the machine"
Page 425 Nov. 21. 73. Mechanical
description of "Alliance" Gramme
Siemens and Halske machines
"Lo is the ~~part~~ Siemens part of the arbor on which
"the useful current is collected by means
"of the silvered copper brushes
Page 294 ~~Feby 27~~ 1873 Gramme Mach.
"The rubbers which collect the current are
"composed of a great number of copper
"wires which are held together in a plate
"in the form of a broom,"

Page 192 March 14.73 Gramme Mach

"They are composed essentially of
"bundles of silvered copper wire grouped
"together and held in position by
"plates and adjusting screws."

Page 291. Apr 25.73 Gramme Mach.
Historical & Scientific description of Gramme Machine
"Two metallic brushes are in contact
"with the arbor; they collect the current
"as it is generated and transmit it
"to two large nuts." ——
"Connect them with the same number
"of copper conductors, placed longitudi-
-nally on the arbor. These conductors are
"insulated from one another, and it
"is from them that the brushes collect
"the current."
"These currents are led to the arbor of the
"apparatus where they may be collected

Engineering

"by suitable metallic pieces at the
"neutral points."
Page 289 April 26. 1872 Siemens Mach.
"Each rubber rests always on several parts
"of the junction between the ~~pairs~~ elements, the
"resistance of which, thus closed by the rubber,
"is suppressed by the resistance of the circuit."

Page 67. Vol 12. Describes Gramme
machine = no copy at Coopers Library —

Engineering searched back to 1871.
including Second half of 71 — from May
to ~~December~~ July Not in Library. And none
back of 1871 —

Page 117

"In a uniform field the lines of force are
"straight parallel and equidistant,
"and the equipotential surfaces are
"planes perpendicular to the lines of force
"and equidistant from each other."

Page 147

"Every part of the conductor moving in
"a field and conveying a current
"(induced or not) is acted upon by a
"force perpendicular to the plane passing
"through its own direction and the
"lines of magnetic force in the field".

Page 153

"If some extra constant resistance be
"connected with the coil, by sliding con-
"tacts near the axis, the current will be
"larger with many than with few turns."

Page 282 Jenkin - Clarke's Machine

"Two ends of the wire are directly joined, but "the two other ends are connected through a "set of springs rubbing on suitable contact "pieces on the axis, with two fixed terminals "and the circuit is not complete till these "are joined."

Page 284.

"It is easy to arrange a set of contact "pieces on the axis so that although the "current must necessarily be reversed in "the coils they flow always in one direction."

Page 285 - Holmes Machine -

"Alternate coils have their iron cores "magnetised in opposite directions."

Page 286

"If the change in magnetisation could "take place instantaneously there would "be no limit to the electromotive force "these machines could produce." —

— "The change of magnetisation and of "direction of the current occupies a very "sensible time; and if the speed be in- "creased beyond that at which the greatest "change of magnetisation occurs, the "electromotive force will fall off instead of "increasing."

Page 259 - Siemens Machine,
"The wires of the coils move almost di- "rectly across the lines of magnetic "force and the armature will be so "magnetised as to help the induction "so produced."

Notes, Article on page 56. of 73

Philosophical Magazine June 1873

Phil. Trans. clvii (1867)

Phil Mag. S. 4. Vol. 34 - page 81

Proceedings of the Royal society V. 15 - page 369

Pro. of Literary & Phil Society of Manchester – Vol 6 page 103.

Same – Dec 15. 68 Phil Mag S. 4. V. 37 p. 4

Comptes Rendus de l'Acad. des Sci. July 71 – Dec. 72 – (Gramme machine)

Page 252 April 9. 1869 - Wilde, inch

"A pair of rings and a commutator "were fitted upon one of the armature "spindles, which was made sufficiently "long for the purpose, and metallic "connection was established between "the rings of each machine and the "commutator on the prolongation of "the armature axis."

Page 56 July 25. 1873 - by Wilde,

"The segments are made to overlap each other "for a short distance so that the metallic "rubbers or brushes for taking off the "current bear on adjoining segments "simultaneously at the point of no "current and in so doing form "two closed metallic circuits for a "brief interval".

Engineer

Page 52. July 17. 1874. Siemens described

Page 228. Aug 2.75: Wilde recites "Nuovo Cimento" of 1864 Vol xix, p 378" "by which to show that Gramme was anticipated by Dr Antonio Pacinotti.

Page 312 May 4. 1877.

"If we make the curve of magnetization "of soft iron according to the values "obtained, we find" etc

"After reaching the turning point the "curve of magnetization goes at first "with a strong, then with a very slight "concavity to a maximum value."

"From the remnant magnetic moment of a "bar, a function of the previously acting "magnetic force, a curve of magnetization "was constructed."

Page 302 Oct 26, 1877. Report of Prof Douglass on Efficiency, size, and cost of Holmes Siemens's Gramme's Machines

Page 383 Nov. 30, 1877

General description of principles of Machines quoted principally from M Fontaine and "Eclairage a l'Electricite, Renseignements Pratiques." Continued pge 401

Pge 401 Dec. 7, 77. Describes, Wildes Alliance, Siemens, Ladds, Van Malderen Appt.

"The currents are all collected at two "conductors one of which abuts on the "axis and is thence put in communication "dation with the rest of the apparatus.

Pge 435 Dec 21, 77 (continued above) Describing the Gramme refers for a more full and complete description to "Annales de Chimie et Physique"

Page 435 - Dec 21. 77 - Gramme

"In order to collect the electricity produced "the insulating material is removed from "the wire in a narrow band round "the outside of the ring and two rubbing "collectors take it up much as in other "machines already described."

"The tails of the radius bars are all "grouped together round the external "axis and they are rubbed against by "suitable collectors which take up the "electricity."

Page 427 June 21, 1878. Machine Test at Franklin Institute describing Brush, Wallace Farmer & Gramme. —

"Upon the surface of the commutator "rest bundles of soft iron wire by which "the current generated in the armature "coils are conducted to the external "circuit." —

Engineer

Page 448 June 21, 75-

"Brush"

"The commutator brushes which are
"composed of strips of hard brass
"joined together at their outer ends
"are inexpensive and easily renewed".

Page 295 Oct 25-1878

Wallace Farmer Machine. Illustrated
& described, - Reference to the figures for the
disposition of the brushes & commutator -

Page 329 Nov-8. 1878

Gramme Machine illustrated & described -

"Take any two diameters of this ring, at right
"Angles the one to the other, and so place it that
"the ends of one diameter are just opposite the
"two poles of a permanent or electro magnet. The
"inductive action of the magnet forms poles in
"the soft iron at the extremities of this diameter
"whilst the extremities of the other diameter are the
"points where the opposing magnetisms meet,
"and here he establishes his brushes or collects
"his currents,"

Engineer

Page 128 Aug 23. 78.
Report by Houston, Thompson et al on
Brush, Wallace & Gramme Machines

Page 113 Feby 14, 1879
Illustrates & describes Edisons Lamp and
Generator (Plain & turning part) –

Page 349 May 16, 1879
Experiments and tests on Siemens Machine by
Institution of Mechanical Engineers –
"The armature coil has fifty six divi-
"sions, and the brushes are single; not
"divided, – that is, each brush is in
"connection with one segment of the
"commutator at any instant" – [illegible]

[illegible] 1881

"The direction of displacement being
"the direction of magnetization and
"the amount of displacement the intensi-
"ty of magnetization."

Page 222

"The magnetization at each point will
"be due not only to the external
"magnetic forces, but to the induced
"magnetism through the rest of the
"body — —We may suppose each
"element of the mass magnetized
"along lines of force, the strength
"of magnetization being given by the
"above formula."

Page 276

"Having the line (cc) joining their
"centres in the direction of magnetiza-
"tion

Cumming Page 278

"Suppose a sphere rigidly magne-
"tized with intensity placed with
"its lines of magnetization along
"the lines of force in the field."

Page 281

"If a small sphere of unmagnetized
"matter be placed in the field it
"will be magnetized along the
"lines of force."

Dynamo references

Eng. Phil Mag.

VIII	1854.	191, 201	o not examined
XXII	1861.	369, 376	✓ P. 93
XXX	1865.	457 458	✓ P 95
XLII	1871.	53, 55	✓ —
XXXIV	1867.	368, 372	✓ —
XXXVI	1868	235 238	✓ P 97 {Wilde page 31}
XXXVIII	1869	166, 168 405	✓ P 99
XLV	1873	40. 57	✓ P 99 101 {[illegible] page 31}
XLIV	1872	414, 417	✓ —
III	1833.	122, 125	o not
XXVIII	1846 -	448, 458	✓ P 89 - {[illegible]}
VII	1835	107, 113.	o not
XII	1838	190 196	o not examined
XV	1839	161, 165	o not examined

French Annal de Chemie.

XLII	1854.	247
XXXVII	1853.	84 [illegible]
XLVIII	1831 -	412. 430
XXII	1823 -	201, 205
LX	1835 -	261, 277

ff. Seine et Oise Mem

II, 1842 – 137. 160

g. Akad Sitzungsb.

LVII, 1868. (abth. 2.) 532, 547.

g. Carl Repertorium

V. 1869, 14-29.
IV 1868. 65.58
VI 1870 308. 322

4a. Roma Atti Nuovi Lincei
XXV 1872 131. 137

2ne Roma Bull. Meteorol
III, 1864 - 25.26 - 33.35 - 41. 42

ew. Poggend Annal

CXX	1863	650 658
XCII	1854.	452. 466
XLVII	1839.	76. 100
LXXXVII.	1852	512. 540 - 312. 314
LXXVI	1849.	494. 523.
LXXXVI	1852	597. 600 -
CV	1858 -	547. 550.
XXXIV	1835 -	270. 271
LXIV	1845 -	55. 64
L .	1840	636. 637.
LIII	1841	313. 315
LXXXVII	1852	352. 356
CI	1857 -	271. 274
LXI	1844 -	417. 430
LXIX	1846	81 - 92
LXXVII	1849.	467. 466 - 493

LXI. 1844 431. 1115
LXXIII, 1848, 193, 2110
CI, 1857, 139, 143

3r. Annal Phys. Chem - Majocchi +

CXXVI	1865.	172 176
CXXXI	1867.	653. 656 - 635. 643
CLXIX	1873.	62. 73
CXXXVI	1869	31. 50
CXXXIII	1868	53 56
CXXX	1867.	332. 335
CXXXVII	1869.	483. 487 - 578. 535
V (Erg. band)	1871	648. 653
CXCI..	1869	89. 103
+ XXVII	1847.	5[illegible]

Fr. Zurich – see Booth No. 128, page 805

XI. 1866 182, 194

En. Franklin Inst. Journal

XLIX –	1865 –	392, 394
LV	1868	17, 28
XIII	1834 –	155 – 156

Fr. Comptes Rend

XLV	1857	367. 369
XXXII	1851	682. 683
LIII	1861	1104. 1107,
XL	1855	954. 957 – 1139. 40
XLV	1857	414, 417
XLIII.	1856	802 805
XLIV	1872	526. 528
LXIII.	1866	881. 882
LXXVII.	1873	561. 562 – 1303, 1304.
LXVII	1868	530. 531 – 321
LX	1865	110
LIX	1864	959
LXVI		
LXXIII	1871	726. 729
XLIV	1867	1197. 1200

En. Nature

VI. 1872 – 64

Fr. Paris Ecole Norm. An. VII, 1870, 181, 209

En. Report for Thames 1, 184 – 1. 18.

Fr. Paris Mem Ingén Civil. 1866: 363, 375

1865: 376, 390

Eng. Amer. Journal Sci

VI – 1873		416. 425
XXII	1832	409. 410
III.	1872	346, 347

Eng. Royal Soc. Proc.

XV – 1867		367. 369–372 403, 404
XII	1836	412, 413

Ger. Wien Akad. Sitz. ber

LIX	1869.	(abtheil 2)	693.769.
LIII	1866.	" "	308, 325
LXI	1870	" "	791.796
LXVII	1873	" "	417. 432

Fr. Revue Marit XXIII, 1868, 915.989

Ita. Milano Ist Lomb. Rendiconti,

IV	1871	25. 34

Ger. Dingler Polytech Journal

CLIII	1867.	417. 434
LVIII	1840	332. 337
LXXXVI	1842	22, 28

Eng. Sturgeon Ann. Electr.

III.	1838,39 —	14.16
II	1838.	203.206
VII	1841	211.212
I	1836	37-470.487
V	1840	32,33

Eng. Brit. Ass. Rep. 1838 (pt. 2) 20.25.

Eng. Calcutta Journ. Nat. Hist.
VI — 1846 — 177.184

Ital. An. Lomb. Sci. Veneto
VI — 1836 — 152.161.

Ital. Atti Scienz. Ital. 1843. 503.505.

Fr. Montpellier Acad. Sci. Mem.
II — 1851-54 — 441, 443

Ger. Heidelberg. Verhandl. Nat. Med. Ver.
1857-59 — 247-250

Eng. Edinb. Phil Journal
VI 1822 – 83.85 – 220.224

Ital. Ann. Soc. Lomb. Veneto. (Bib 128 pgi 247)
I – 1831 – 275.280
IV 1834 – 67.80
II – 1832 166.169

Ital. Modena Soc. Ital. Mem.
XXI 1837 323.334

Ital. Amici Giorn Toscano.
1. 1840 – 506.512

Eng. Silliman Journal
XXXIII 1838. 118.120.
XXXII 1837 1-8. (245) 315.317.

Fr. St Petersb. Acad. Sci Bull. I
I – 1836 121.125

Eng. Amer. Phil Soc. Trans – Phil Tran.
1. 1818. 427.429
+ 1833 333.342

Eu. Baumgartner Zeitschrift

VII — 1840 — 65. 78

Eu. Schweigger Journ.

LVIII (= Jahrb. XXVIII) 1830 273. 277.

Eu. Berlin Bericht — 1843 — 291 – 299.

1851 — 670 – 674.

Fr. Eng. Am. Telegraph

11. 1859 — 409. 413.

Fr. Bibl. Univers Archives

XXXIII 1856. 198. 213 —

Eng. Tilloch Phil Mag.

XX 1805 — 159. 160

Ger. Liebig Ann.
LXXV 1850. 83, 94.

Eng. Lond Elect. Soc. Proc. 1837-40- 183

Ital. Il Nuovo Cimento
III - 1845 - 225, 234

Phil. Mag. 1846 Page 449

Dr Scoresby's armature described by himself -

One consisted of a hollow tube of drawn iron 24 in long 1 5/8 in. diameter & 3/16 in thick bent in shape of U - saw cut the entire length - each leg wound with 274 feet covered copper wire 1/10 in in diameter -

The other armature consisted of two bars of iron each 20 in. long. 4 in broad and 3/8 in thick bent edgeways in the form of a semicircle fastened together with the interposition of calico to prevent currents in the iron, each leg wound with two coils same size wire, the coils nearest the iron were 276 feet long the other coils 296 feet long -

Placed between two straight steel

Refer also to Dr Scoresby -
"Magnetical Investigations"

Magnets each 4 ft 4 in long 4 to 5 in square poles of 7½ square inches surface, placed in a horizontal position with two of their poles connected by a suitable armature with the hollow armature, 500 turns per minute gave the maximum amount of decomposition - ¾ cubic inches mixed gases per minute.-
The flat semicircular armature at 500 Revs. gave 1.4 cu. in. gases per minute, and heated to bright red heat 2 in steel wire $\frac{1}{50}$ in thick & fused 1 in same wire.-
Results expected to be augmented by rotating the armature opposite the two poles of the magnets and not as in above case opposite their ends

Phil Mag 1861 Page 369

Dr. Lamont on most advantageous form for magnets.

"Narrower magnets are more advantageous than broader.

"Thinner magnets are more advantageous than thicker

"The most advantageous form is that in which breadth and thickness disappear and the magnet is transformed into a mathematical line i.e. into a so called linear magnet."

Two forms appear advantageous viz. "flat contracting to a point from the middle," and the flat prismatic."

— "There is only one means of obtaining great magnetic strength with trifling weight; namely, by firmly connecting several thin and flat magnets near or upon one another in one system without their touching each other."

Dr Menzger. Relation of the weight of a magnetizing spiral to the magnetizing force, —

"It is assumed that the maximum "of intensity is in all cases obtained "when the essential resistance, or that "offered by the battery, is equal to "the external resistance in the inter-"polar i.e. in this case the magne-"tizing coil". ———

"The magnetizing power of two coils "which give the maximum of intensity "are as the square roots of their "weights".

Phil Mag. 1868 - Page 235 -

Jamin and Roger on Magneto Elec Machines.

"Our machine consists of six rotating
"plates each provided with sixteen
"bobbins joined in tension and
"forming a total resistance R of
"twelve turns of the rheostat". These
"plates are joined in quantity so as to
"form an electromotor of six inde-
"pendent machines sending their
"electricity into a common external
"circuit". — from Comptes Rendus June
-1, 1868 -

Phil. Mag. Pge 405 - 1869

On the limit of magnetization of iron and steel. Prof. Waltenhofen.

"The theoretically possible temporary
"magnetization of iron is more than
"five times as much as the permanent
"which has been attained by the best
"steel magnets." — Sitzungsberichte
der Kaiserlichen Akademie in Wien, 1869

Phil. Mag. 1873 Pge 42

Dr. A. Stoletow - On the magnetizing Function of soft iron.

"If m. is the magnetic moment of an
"elongated ellipsoid of rotation which
"is magnetized by a constant force
"X acting parallel to the polar axis".

Joule's experiments in Phil Mag of 1847

Mayer on the effect of Magnetism in changing the dimensions of iron. 1873 Vol XLV Pge 350

Also on Page 438 H. Wilde on some improvements in Electro magnetic Induction machines

(Same) Phil. Mag. Pge 48. 1873

"The induced electromotive force increases "proportionally with the number of secondary "turns. That it depends only on the number "and not on the quality of the turns."

= The above are two References taken from the Note Books, [illegible] in possession of Dr Moses.

Phil Mag. 1861. Vol. 19. Pge 320

Electric Light in Lighthouse Illumination — Holmes machine for light in South Foreland High Light

"The wires of the helices are conjoined and "connected with a commutator, which, "as the magnet wheels are moved round, "gathers the various electric currents pro- "duced in the helices and sends them "up through two insulated wires in "one common stream of electricity into "the light house lantern."

Phil Mag Vol 20. 1860. Page 458

"On the Molecular changes produced by Magnetization - by W. Beetz. Translated from Poggendorff's Annalen"

"It is impossible to obtain a thick magnet as completely saturated as a thin one."

"There never can be a magnet completely saturated with temporary magnetism."

"The most powerful magnetizing currents will never be able to bring the axes of the particles into perfect parallelism with each other."

Vol 21, 1861 Pages, 65-92-250

Prof Challis on a Theory of Magnetic Force

Vol 21. 1861 Page 161-281-338 (Contd)

Maxwell On physical lines of force

Vol 21. 1861, Page 311

Some results in electro magnetism obtained with the balance Galvanometer. by Geo. Blair.

Reference to Paper by Sir W. Thompson "On a Mechanical Representation of Electric Magnetic and Galvanic Forces. Camb. and Dublin Math. Journ. Jan. 1847

Wiedermann's investigations on the magnetization of steel bars. Poggen. Annalen V.c. p 241

Phil Mag Vol. 22. 1861 Page 369

On the most advantageous form of Magnets by Dr Lamont Transd from Poggendorff's Annalen Vol cxiii P 239.

See page 3 this Book

Phil. Mag. Vol 23. 1862 Page 12 (contd)

J. C. Maxwell on Physical lines of force

"Magnetic induction may be accounted for "on the hypothesis of the magnetic field "being occupied with innumerable vortices "of revolving matter, their axis coinciding "with the direction of magnetic force at "every point of the field".

Same, page 54

"Prof Challis (Phil Mag Dec 60. Jan & Feby 61) "conceives magnetism to consist in currents "of a fluid whose direction corresponds to "with that of the lines of magnetic force"

Phil Mag Vol XXVII 1864 Page 498

"On the variation of magnetic force with "the temperature - by M. Mauritius from Pog. Ann. November 1863 -

Phil Mag Vol 27. 1864 - Page 506 Contd

"On the electric currents induced by a
"Magnet in a rotating conductor -
by E. Jochmann - from Journal für die
reine und angewandte Mathematik Vol
LXIII p 158.
Continued in Vol 28. page 347 -

Phil Mag Vol 29. 1865 - Page 113
On an Anomalous Magnetization
by Prof. A. von Waltenhofen - translated
from Berichte der Wiener Akademie
der Wissenschaften

Same Vol page 152
A Dynamical Theory of the electro-
magnetic field - by J. Clark Maxwell -

Vol. 32 Page 118
Experimental Researches in Magnetism
and Electricity by H. Wilde Esqr
"On a magnet cylinder of brass or iron
with internal diameter of 1 5/8 in could
be placed one or more permanent

"horse shoe magnets, An armature
"was made to revolve rapidly in
"the interior of the cylinder in close
"proximity to its sides but without
"touching, Around this armature 163
"feet of insulated copper wire was
"coiled 0.03 of an inch in diameter and
"the free ends of the wire were connected
"with a commutator fixed upon the
"armature-axis for the purpose of taking
"alternating waves of electricity from
"the machine in one direction only." —

Two magnet cylinders were made
"and fitted with an armature, around
"which was coiled an insulated
"strand of copper wire 67 feet in length
"and 0.15 of an inch in diameter" —

"A 10 inch electro magnetic machine
was constructed; the weight of the electro
magnets is nearly 3 tons, and the
total weight of the machine about
4 1/2 tons. The machine is furnished

"with two armatures, one for the
"production of intensity and the other
for the production of quantity effects.
"The intensity armature is coiled
with an insulated conductor consisting
of a bundle of thirteen No. 11 copper
wires each 0.125 of an inch in diam-
eter. The coil is 376 feet in length
and weighs 232 lbs."
"The quantity armature is envelop-
"ed with the folds of an insulated
"copper plate conductor 67 feet in
"length the weight of which is 344
"lbs." Armatures driven 1500 turns
in minute.

Vol. 32 - Pages 378 & 433
Remarks on the Dynamical theory of
electricity - by C. Brooke,

Vol 32 Page 457.
On the influence of magnetization
on the length and the resistance of
iron bars". by Prof W. Beetz

Phil Mag Vol 33. 1867. Page 63

T. R. Robinson on increasing the electricity given by Induction Machines

"The secondary helix may be made
"of longer or thicker wire — the length
"does not increase the quantity of
"the current at all — the effect of
"the thickness is limited" —
"The analogy of the battery suggests
"combining several helices collaterally
"as is done when cells are arranged
"for quantity —

Vol 33. Page 469

Mr. C. W. Siemens on the conversion of Dynamical into electrical force without the aid of Permanent Magnets —

"An electro magnetic machine consisting
"of one or more horse shoes of soft
"iron surrounded with insulated wire
in the usual manner, & a rotating
keeper of soft iron surrounded also

"with an insulated wire and of
a commutator connecting the
respective coils in the manner of
a magneto electrical machine,"
Vol 33 Page 471,
On the augmentation of the power
of a magnet by the action thereon
of currents induced by the magnet
itself - Charles Wheatstone
"The core of the electro magnet is formed
of a plate of soft iron 15 in in length
and ½ an inch in breadth, bent at
the middle of its length into a horse-
shoe form, round it is coiled in
the direction of its breadth 640 feet
of insulated copper wire 1/12 of an
inch in diameter. The armature
consists of a rotating cylinder of
soft iron 8½ inches in length
grooved at two opposite sides so
as to allow the wire to be coiled
upon it longitudinally; the

"length of the wire this coil
"is 80 feet and its diameter the
"same as the electro-magnet-coil".
— "Stronger effects are produced at
"the first moment of completing
"the combined circuit than afterwards".

Vol 33 Page 276
On the theory of maintenance of
electric currents by mechanical
work without the use of permanent
magnets, by Jules ? Maxwell, &c.

Vol 33. Page 323
C. F. Varley on certain points in the
theory of the magneto electric ma-
chines of Wilde, Wheatstone and
Siemens —
"An opportunity afforded me of ex-
"perimenting with Mr C. Siemens ma-
chine, in which the electro magnets
have each a resistance of about
250 ohms = 500 ohms, the armature
400 ohms.

Phil Mag Vol 33. 1867 Page 544

On a Magneto electric Machine by Wm Ladd.

Phil Mag Vol 34. 1867 Page 81

Experimental researches in Magnetism and Electricity by H. Wilde.

"If round the piece of iron forming "the armature of a permanent "magnet a quantity of insulated "wire be wound at right angles "to the line which joins the poles of the magnet and if the free ends of the wire be connected together directly or indirectly by the inter- "position of some conductor," a "momentary wave of electricity is generated every time the armature is made to approach or recede from the magnet."

 Books examined on Dynamo May 14 1881
Machines etc = "Line of Magnetization"
1 Higgs — 2 Sawyer — 3 Preece
4 Schoolbred — 5 Sprague,
6 Engineering 1878 7 Jenkins 1879
8 Engineer 1869 to 1881 — 9 Cumming 1879
10 American Cyclopedian —
"For Dynamo Machines generally
Physiological Magazine,

Phil Mag. 1860 Vol 19 Pge 241

"A large receiver in which a vacuum had "been obtained by filling it with carbonic "acid gas, exhausting it, and permitting "the residue to be absorbed by caustic "potash" was placed &c—

Phil Mag Vol. 23. Pge 13. A

"A charge of electricity has been preserved "(by W. Thompson) in a glass vessel for "years without penetrating the thickness "of the glass."

Vol 12 Pge 67

Phil Trans. 1832 pge 32 - Faraday

Menlo Park Notebook #214 [N-81-02-20]

This notebook covers the period February-July 1881. The entries are by Charles L. Clarke and relate to dynamos. Included are notes, calculations, and drawings of the Porter-Allen central station dynamos, the South American portable dynamo, sizes E, F, and C dynamos, a steamboat dynamo, and a flywheel for an Armington-Sims steam engine dynamo. Thirteen loose pages found in the book contain additional notes, drawings, and calculations. The label on the front cover is marked "C. L. Clarke" and "Magnets." The book contains 278 numbered pages.

Blank pages not filmed: 72-99, 104-109, 224-253, 268-269, 278.

X E-172 N-81·02·20

Calculations for C. L. Clarke. 1
South American
Portable dynamos. Feb. 20, 1881

Dynamo with 10¼" field diameter.

By the test of Jan. 29, 1881 the E.M.F. on lamps was 164 × .675 volts = 110.7 Volts. A

The E.M.F. on magnet-circuit was (30.95 ohms resis.) 240 volts.
Of this resis. 17.05 ohms were in the magnets, the remainder being in the regulating resistance.

The E.M.F. on the magnets was therefore 132.2 Volts.

and with 11 magnets in series the fall on each was 12 volts.

which corresponds to a deflection on the high resistance galvanometer in this case of 17°8.

The deflection of 164° corresponds to an average speed of 1203 revs. per minute and at 965 revs. the deflection would be

131°6

This with 17°8 on the magnet corresponds closely with experimental curves determined Dec. 10 1881.

Each core has 690 turns
in 3 layers of No. 10 copper
wire and average ~~distance~~
diameter of 6.456 ~~feet~~ inches
Length of one turn

6.456 X 3.1416 = 20.28 inches

Total length on both
cores 27986.4 inches

= 2332.2 feet.

The resistance is

$$\frac{10.64 \times 2332.2}{(130)^2} = 1.\cancel{38}\,47 \text{ ohms.}$$

The wire was not exactly No. 10 of .134 diam. but .130 diam.

With an assumed conductivity of 97.

The weight of the wire
is 2332.2 X .054353

= 126.76 lbs. but since
wire was .130 diam.

= 119.3 lbs.

If the armature were single wound instead of double the E.M.F. would have been 55.35 Volts.

Suppose

T = turns of wire
C = Current
E = E.M.F.
R = resistance

Then Efficiency $= C \times T$
and Energy $= C^2 \times R$

If wire is of half the cross section but same weight $r = 4R$.
$t = 2T$

Efficiency $= c \times t$.
which assume to be the same as before

$\therefore \quad c \times t = C \times T$

but $t = 2T$

$$\therefore \quad c = \frac{C}{2}$$

Energy $c^2 \times r = \frac{C^2}{4} \times 4R$

$$= C^2 \times R.$$

The amount of energy in the two cases is therefore the same.

To produce however half the current C through four times the resistance R requires an E.M.F.

$$= 2E$$

Therefore with a given weight of copper and a constant efficiency and constant energy

$$E.M.F. \propto T$$

$$C \propto \frac{1}{T}$$

$$R \propto T^2.$$

Also Cross-section of wire $\propto \frac{1}{T}$

Efficiency $\propto$ (diam. of core)$^{1/2}$,
Efficiency $\propto$ (length of core)$^{1/2}$,

The present dynamo gives 55 volts at the speed of 1203 revs. ~~at~~ near the saturation point which would not be well to regulate automatically. A lower point on the curve of magnetism should be taken where the curve is approximately a straight line, say at the point where at 965 revs. the E.M.F. is 39.15 Volts with ~~7.425~~ 6.75 Volts in the magnet.
At 1203 revs = 48.8 volts

If x is the product of the length by the diam. of core

$\sqrt{x} : 55 :: \sqrt{36 \times 6} : 48.8$

$\therefore x = 275$ approx.

If the core is still kept 6" diam. the length will be 46 inches.

If 6½" diam.
length 42½".

The size of cores will be 6½" × 42½".
but ½" will be added to the length to allow for fiber and iron washers.
The yoke will be 6½" deep by 7½ wide.

The field ~~will retain its present dimensions. width 9¼"~~ be 9½" wide.

Amount of copper 120 lbs.

On each core - 60 lbs.

The energy required to be developed in entire magnet circuit is

$$\frac{6.75^2}{1.47} \times 44.3 = 1373 \text{ ft-lbs.}$$

On the cores to separate the coils from the yokes and poles must be placed fiber rings.

Feb. 21, 1881
Clarke

Suppose no resistance in the magnet circuit other than the coils in the magnet itself the resistance required to give the energy of 1373 ft. lbs. on 55 volts will be

$$\frac{55^2 \times 44.3}{1373} = 97.6 \text{ ~~volts~~ ohms.}$$

or a current .563 webers.

~~The small magnet intended for the regulator has a core 18" long by 3" diam. and this must be at all times saturated~~

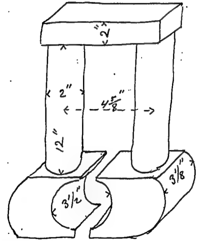
See page 37 for continuation of resistance.

Feb. 25. 1881 Clarke.

For regulator use a magnet 1/3rd the size of the medium machines.

Core 12" long × 2" diam.

Yoke 2" ×



Let the amount of copper be in proportion to that on the medium machines which have 120 lbs. The

amount for the regulator
will be $\frac{120}{27}$ =

Armature Feb. 21, 1881

Clarke

The field will be $10\frac{1}{4}$" diam.

Clearance between field and armature binding wire $\frac{3}{100}$".

Diam. of brass or German silver binding wire $\frac{2}{100}$" (Number 25 B.W.G.)

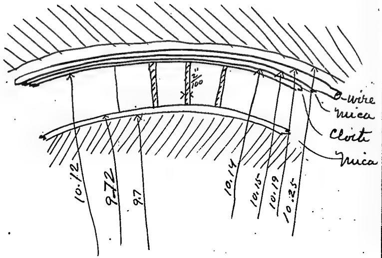
Mica under binding wire $\frac{5}{1000}$" thick

Cloth covering under mica $\frac{10}{1000}$" thick

Mica over armature and under copper rods $\frac{10}{1000}$" thick

Depth of copper rods on armature $\frac{2}{10}$".

Diam. of armature core $9\frac{7}{10}$".



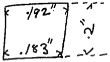
Diameters

The 150 divisions of the armature are on an outer ~~radius~~ diam. of 10".12 and inside diameter of 9".72.

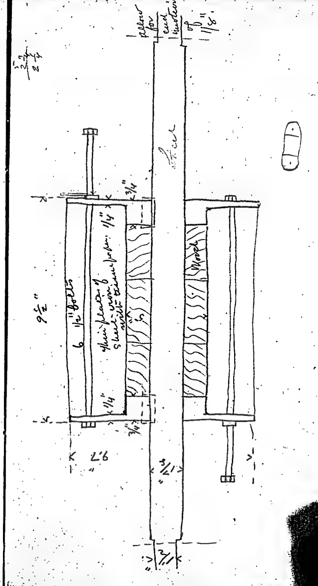
Width of 1 division on outside diam. .212"

ditto inside .203"

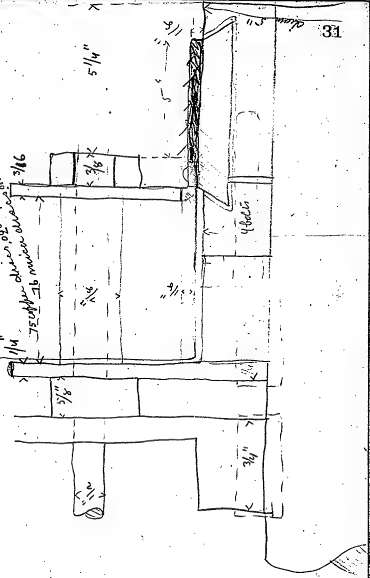
With a separating insulation of $\frac{2}{100}$". the actual width becomes .192" and .183".



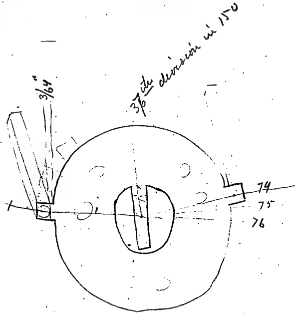
See page 53 for Commutator blocks.



Wood


5 1/4"
3/16
3/8"
1/4"
75 copper discs .028"
76 mica discs .011"
4 bolts
5/8"
3/4"

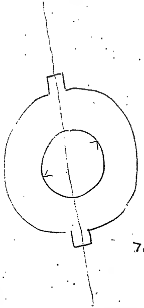
150 divisions



75 blocks with 1/32" insulation

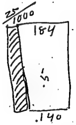
3,1416
5
75)15.7080(.2094
15 0xxx
708
675
330

.2094
.025
.184



3,1416
4
75)12.5664(.1675
75xxx
506
450
566
525
414

.1675
.025
.1425



Commutator blocks

From page 17.

The ft. lbs. actually required to saturate the medium sized magnets is

$$\frac{20 \times .675^2}{1.47} \times 44.3 = 5492 \text{ ft. lbs.}$$

but with the magnet 1/2 inch larger in diam. and length 7" greater and also considering the fact that the E.M.F. will be of the required intensity some distance down the curve from the saturation point (only 1373 ft. lb. being actually required) we will assume 3500 ft. lbs. as required of which the half may be used up in regulating resistance but actually the effect will be by Counter E.M.F. of the regulating motor.

The necessary resistance will be

$$R = \frac{55^2 \times 44.3}{3500} = 38 \text{ ohms}$$

If L is the length of conductor and D the diam. in thousandths of an inch

$$R = 38 = \frac{10.64 \times L}{D^2}$$

but weight is 120 lbs. and one mil-foot weighs .000003027

$$\therefore \quad D^2 \times L \times .000003027 = 120$$

$$L = \frac{120}{.000003027\,D^2}$$

$$\therefore \quad 38 = \frac{10.64 \times \frac{120}{.000003027\,D^2}}{D^2}$$

from which

$$38 D^2 = 10.64 \times \frac{120}{.000003027\,D^2}$$

$$\therefore .000115026 D^4 - .0000322073 D^2 = 120$$

$$\therefore D^4 - .28 D^2 = 1043240$$

$$D^4 - .28 D^2 + .0196 = 1043240.0196$$

$$D^2 - .14 = \pm 322.99$$

~~$\therefore\ D^2 = 323.13$~~

~~$\text{or} = 322.85$~~

~~$\therefore\ D = 17.975$~~

~~$\text{or} = 17.968$~~

~~Assume No. 26 B.W.G.~~

~~of $\frac{18}{1000}$" diam:~~

Suppose the weight in a rod 1 ft long - 120 lbs.
Since a mil-foot weighs .00000 3027 there would be

$120 \div .000003027 = 39643211$ miles in the rod.

For a constant weight of metal Resis. $\propto$ (length)^2.

Resis. of this rod is $\frac{1064}{3964321100}$ ohms

but since the resistance is to be 38 ohms the length L

$$L = \left(38 \times \frac{3964321100}{1064}\right)^{\frac{1}{2}}$$

$$\therefore\ L = (141582896)^{\frac{1}{2}} = 11898 \text{ feet}$$

The mils in cable vary inversely as L, therefore the Circular Mils $= \dfrac{39643211}{11898}$.

$= 3332.48$

Diam. $= (3332.48)^{\frac{1}{2}} = \dfrac{57.7}{1000}$ ''

By taking No. 17, B.W.G $= \dfrac{58}{1000}$ the ~~resistance~~ number of feet will be 11784.5 feet.

The Resistance

$R = \dfrac{10.64 \times 11784.5}{(58)^2} = 37\tfrac{1}{4}$ ohms.

See p. 51.

Since on $37\tfrac{1}{4}$ ohms 1373 ft. lbs. are required at the least to be developed, the weight of copper not having been altered, the E.M.F. necessary is $E = \left(\dfrac{1373 \times 37\frac{1}{4}}{44.3}\right)^{\frac{1}{2}} = 34$ volts.

55 volts being all required
of the machine at this
point - the ~~remaining~~ total
resistance for regulation
will be $\frac{55 \times 37\frac{1}{4}}{34} = 60\frac{1}{4}$ ohms
The regulating resistance
outside the magnets will
be $60\frac{1}{4} - 37\frac{1}{4} = 23$ ohms.
To have a margin and
for making the lights
less brilliant introduce
22 ohms extra making in
all 45 ohms in boxes.
If made of German
silver wire of $\frac{32}{1000}$" diam.
No. 21 B.W.G. the necessary
length will be

$$L = \frac{45 \times \overline{32}^2}{10.64} \times \frac{1}{7}.$$

$$= 620 \text{ feet.}$$

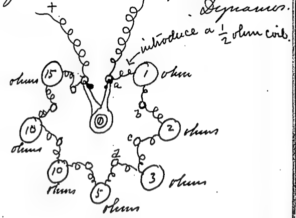
If we have 5 boxes of 1 ohm
each the length of wire
on each will be 15.5 feet
and on each of the 5 ohm
boxes (of which there will
be 8) 77.5 feet.
If boxes are 3" square there
will be 1 ft. for a turn
and 8 threads to the inch
The height of boxes will
be 9.7 inches. This will
enable them to be placed
in a box 1 ft high.
The 5 coils of 1 ohm each can
be wound in 1 of the boxes
for 5 ohm coils.
The box would be a cube
of 1 ft Must have holes
for air circulation.

See page 49.

Feb. 28, 1881

Clarke.

Resistance box for regulating field for South American Dynamos.



The total length of wire will be 620 ft. or 13 ft 9½" to the ohm.

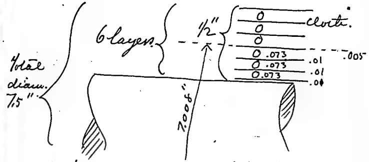
a, b, c, d, &c must be so close that the switch will span the space and circuit never be broken.

See page ~~44~~ 55

If 17 B.W.G. is used on the magnets; the diameter of .058" will be increased by the double cotton insulation to ~~.134~~ *. .073".

There are 42" of available length on the cores.

This gives 575 turns to a layer



With six layers the diameter (mean) will be

$$\begin{array}{rl} 6.5 & \\ .438 & = 6 \times .073 \\ .07 & = 7 \times .01 \\ \hline 7.008 & \text{inches} \end{array}$$

The total length will be 12650 feet and the

resistance

$$R = \frac{10.64 \times 12650}{58^2}$$

$$= 40 \text{ ohms.}$$

Commutator 5" diam.

$$3.1416 \times 5$$

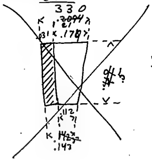
$$75 \overline{)15.7080} (.2094$$

$$150xxx$$

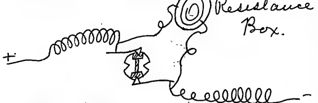
$$708$$

$$675$$

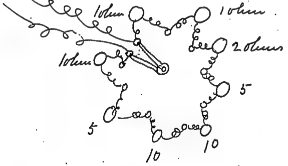
$$330$$



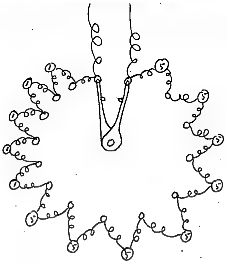
See page 35.

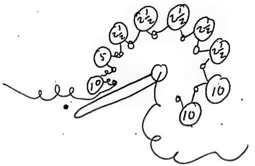


This arrangement controls each resistance. As also does an ordinary plug.



See page 57.

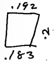




~~For a 20 ohm coil of No. 30 American gauge ($\frac{1}{100}$") are required 196 feet.~~

2 Bunsen cells of 3/10 ohm on 3 ohm magnet give strong suction, This is 4 volts on $\frac{33}{10}$ ohms or $\frac{30}{33}$ of 4 volts = 3.7 volts on magnet. Total resis. ~~[illegible]~~ ohms of which 2 ohms are in magnet of No. 26 copper wire American gauge = 49 feet.
.01594 diam.

Resistance of the South American machine (5.5 volts).



The cross section is

$$\left(\frac{.192 + .183}{2}\right) .2 = .0375 \text{ sq. in.}$$

Since 1 mil (circular) is .0000007854 sq. in.

The no. of circular mils will be

$$\frac{.0375}{.0000007854} = 48001 \text{ cir. mils.}$$

The mean length of the rods is

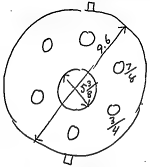
$$\frac{(14.158 + 14.197)}{2} = 14.178 \text{ inches}$$

$$= 1.1815 \text{ ft.}$$

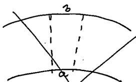
The resistance of this part of the circuit will be

$$R = \frac{10.64 \times 150 \times 1.1815}{4 \times 48001}$$

$$= .009821 \text{ ohms.}$$



Mean ~~radius~~ diam of copper plates 7.4875



If any element of a ring is taken and at a we have for unit length l a unit ~~length~~ weight w of metal $\propto l \propto r$

and mean length on this diam. = 23.5"

Depth of rings 2".1125

thickness .028.

Approximately the cross section is $2.1125 \times .028 = .059$

~~for 18.5 inches~~

~~$\cancel{2.1125}$~~

~~$1.2375 \times .028 = .03465$~~

~~for 1.875 inches~~

~~$1.3625 \times .028 = .0383$~~

~~for 2.25 inches~~

For the diminishing of the cross section by the holes increase length to 25 inches = 2.083 ft.

In .059 sq. in. there will be

$$\frac{.059}{.0000007854} = 75121 \text{ cir mils.}$$

$$R = \frac{10.64 \times \cancel{750}\ 75150 \times 2.083}{8 \times 75121}$$

$$= .0155 \text{ ohms}.$$

The total resistance will be see pages 61 + 65

$.00982 + .0155$

$= .0253$ ohms.

The $\frac{14}{100}$ machine will run 50 A.16 lamps and that is about the limit on account of heat. 115 ohms each.

$\frac{115}{50} = 2.3$ ohms.

110 volts.

$\frac{110^2}{2.3} \times 44.3 = $ (7.06 H.P.) 233057 ft-lbs

The amount developed, as heat, in the machine will be $\frac{14}{230}$ of $233057 = $ $\underline{14186 \text{ ft-lbs.}}$

Total $233057 + 14186 = $ (7.5 H.P.) 247243

Ratio of external to internal 14.4 to 1.

The South American machine has a resis. of .0253 ohms.
The B. 16 light has the same radiating surface as the A. 16 and with $\frac{1}{2}$ the E.M.F. (or 55 volts) and same length as B. 8 it has the same foot-lbs. of energy - Therefore the energy will be (page 67) for 50 lamps 23.3057 ft. lb.
. The resis. external is

$\frac{115}{4 \times 50}$ = .575 ohms and internal is .0253 The heat developed in armature will be

$\frac{253}{5750}$ of 23305.7 = $\underline{1025.4}$ ft. lb.

Ratio of external to internal 22.7 to 1.

In order that as much heat may be developed in the armature in the last case as with the $\frac{14}{100}$ dynamo with A 16 lamps we must have (The ft. lb. for each lamp being $\frac{233057}{50} = 4661$ ft. lb.)

If x = number of lamps the external resis. is

$$\frac{115}{4x}$$

$$\frac{.0253}{\frac{115}{4x}} \text{ of } 4661x = 14186 \text{ ft. lb.}$$

$$.1012\,x \times 4661x = 115 \times 14186$$

$$471.6932x^2 = 1631390$$

$$x^2 = 3459$$

$$\therefore\ x = 59 \text{ lamps.}$$

Dynamo B.

The size of dynamo A is larger than what is absolutely necessary for the given E.M.F. but it was increased so as to make automatic regulation better by being on the straight portion of the curve of magnetism.

At ~~1200~~ 965 revs. the deflection is 131.8 which would give at 1200 revs. 163° def. = 110 Volts. This corresponds to a def. in the magnet of 14° = 9.45 Volts. This is a good point on the curve for economy and regulation. The energy required in the magnets will be 2691 ft. lbs.

The field of the dynamos in experiment have a width of 9 1/4" which we will reduce to 9" or by 2.7% but this can be more than made up in decreasing the diam. of the iron of the core.

The iron of the armature has been 9.7 outside radius and 5 inside and area is expressed by $(9.7)^2-(5)^2=69.09$

But inside radius can be decreased to at least $3\frac{3}{8}$" then $(9.7)^2-(3\frac{3}{8})^2=82.7$ an increase of 5%, thus more than counteracting the effect of decreased width of poles.

Also see 265 page

Central Station Dynamo.

March 29, 1881.

In the Porter-Allen dynamo, by increasing the commutator from 69 to 75, the speed may be reduced to

75 : 69 :: 600 : 552

No. revo. with 75 comm. = 552

By increasing the length of armature from 28" to $33\frac{3}{4}$" the speed may be reduced to 33.75 : 28 :: 552 : 458

No. revo. Arm. $33\frac{3}{4}$" long = 458

To reduce the revolutions
from 458 to 350 the
diam. must be increased
by a ratio of
$1 : x :: 350 : 458$

Ratio of increase
of diam. of armature $= 1 : 1.30857$

Actual necessary diameter
1.30857×19.46

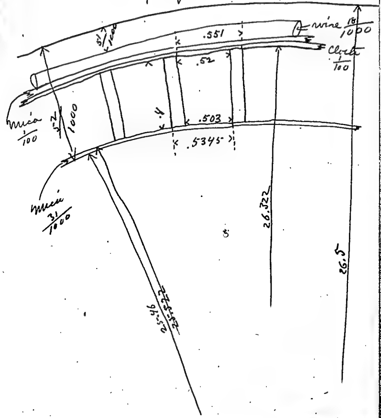
$= 25.46''$.

If the space remains the
same as before $\frac{52}{100}''$ the
diam. of field will be
$= 26.5''$.

21.03
20.968
2)0.062
.031

25.46
.062
25.522

See page 129 for correct sketch



The diam. on the mica insulation is 25."522 and circumference 80."179152 and with 150 bars the space for each on this diam. will be .5345 inches.

With $\frac{1}{32}$" insulation the bottom width of rod will be .503 "

Assume the rods as .40 deep, the diam. on outside ~~dea~~ of armature rods is 26.322 and circumference 82.693 and with 150 bars the space for each on this diam. will be .5513

With $\frac{1}{32}$" insulation the top width of rod will be .52

In the Porter-Allen Dynamo
the following are dimensions
of armature rods

And number of commutator
blocks 69. length 28"

In Central Station Plant

75 commutators, length $33\frac{3}{4}$"
+ $7\frac{3}{4}$" with plates .065 thick
and insulation .02 thick.

Resis. $= \frac{10.64 \times 256.25}{260441}$

$= .01047$

Entire resis. of armature
$= .005235$ ohms.

O. K. March 30, 1881.

By reducing the no. of commutators to 73. the diam. should be increased from 25.46 to

73 : 75 :: 25.46 : 26.16

= 26.16

Which we will increase to 26.46"

Circumference = 83.126736

With 146 armature bars the space for each at bottom is = .56936 and with $\frac{1}{32}$ insulation, actual bottom width = .538

Outer circumference of armature rods with

27,322 diam.

$= 85.8347952$

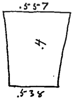
Top space for each of 146 rods $= .5879$

With $\frac{1}{32}$" insulation

$= .557$

Area $= .219$ sq. in.

$= 278839$ c. mils.



Length of each rod 41 inches and total of ~~146~~ 73

= ~~498.83~~ feet

$= 249.415$ "

$$\text{Resis} = \frac{10.64 \times 249.415}{278839}$$

$= .00952$

Total resis $= .00476$ ohms.

$\frac{600}{3}$ $\frac{350 \times 26}{600 \times 20}$

With 120 Horse power outside

$$\frac{110^2}{R} \times 44.3 = 3960000$$

$$R = .13536 \text{ ohms.}$$

Ratio of armature rods to External $\frac{.00476}{.13536} = \frac{1}{29}$

~~Ratio of armature rods to external~~ $\cancel{\frac{.00476}{.1306}} = \cancel{\frac{10}{274}}$

In the $\frac{14}{100}$ ohm machine the loss of energy with 50 lights will be as follows —

Resis. $\frac{50}{115}$ outside with 110 volts drop gives

$\frac{50}{115} : 110 :: \frac{4}{100} : = 10.12$ Volts.

$\frac{10.12^2}{\frac{14}{100}} \times 44.3 = 32400$ ft. lbs.

Armature has the two ends and face to radiate from = $10\frac{1}{4}$ diam. $9\frac{1}{4}$ length

= 463 sq. in.

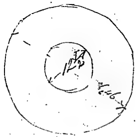
$\frac{32400}{450} = 72$ ft. lbs. per sq. in. to radiate.

Large armature rods.

See page 123. Circumference = 85.835

Surface = $\times$ 41 = 351.9 sq. in

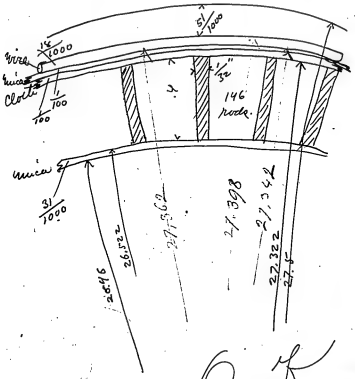
$\frac{136552}{3520} = 31$ ft. lbs. per sq. in. to radiate.



March 30. 1881.

Correct Central Station Dynamo.

Copper discs $\frac{68}{1000}$.
Insulating paper $\frac{20}{1000}$.



O. K.

In the Porter-Allen dynamo with a ratio of internal resis. to external of 1 to 22 the fall of E.M.F. in armature is 5 volts, making a total necessary of 115 volts. To obtain this at 600 revs. the point on the magnetization curve is economical.

The current required to effect this is $\frac{75.0 \times .675}{23} =$

2.201 webers.

~~For a margin assume a deflection of~~

The no. of turns on a magnet is 3720 and product 2.201×3720

$= 8187.72$

23) 116 (5

With new helices. 4 ft 6"
instead of 3 ft 6" as in
Porter-Allen Dynamo
the no of turns will in-
crease in the ratio of
42" to 54"

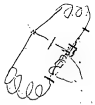
= 4783 turns

Assume that 100 volts will
give the current of 2.201
webers. we must have
a resistance of

Omit

$100 \div 2.201 = 45.5$ ohms.

To get the same current
through 4783 turns of 45.5
ohms as through 3720
turns of 23 ohms
requires a ratio in
diam of copper



$$R = \frac{10.64 \times 4783}{x^2} = \frac{15}{\cancel{45.5}}$$

$$r = \frac{10.64 \times 3720}{(109)^2} = 23.$$

$$\frac{(\overset{15}{\cancel{45.5}})\,x^2}{4783} = \frac{23 \times (109)^2}{3720}$$

$\therefore\ x = 15.4$

The wire nearest to this is No. 8 = $\frac{165}{1000}$, and with insulation would be $\frac{19}{100}$ ~~with cores~~ too large.

With wire .130 and insulation .025 total diam. = .155
4783 turns can be got in 4'6" cores with 7 layers.

.03
.155
.015
.155
.015
.155
.015
.155
.03

Suppose 8" cores

8.170
1
9.170

Omit

Total diam
$8 + (1.17)^2 + (.03)^2$
$= 10.4$ inches
but distance between
centers is $11\frac{1}{4}$".
Therefore .85" clearance
between.

Mean diam of copper
wire is 9.17
Circumference 28.808"
Total length =
$4783 \times 3 \times 28.808$
$= 413365.992''$
$= 34447.166$ feet
Resis $= \dfrac{10.64 \times 34447.166}{130^2}$
$= 21.7$ ohms.

Quit.

With wire .148 and insulation .025 Total diam = .173

.03
173
01
173
01
173
01
173
01
173
01
173
01
173
03

1.301
2
2.602
.06
8.
10.662

O.K.

8
1.301
9.301

Diam = 10.662"

Clearance = 11.25 − 10.662
= .588

Mean diam. of copper wire = 9.301

Circumference = 29."22

Total length of wire

= 4370 × 3 × 29.22

= 383074.2"

= 31922.85 feet

Resis = $\frac{10.64 \times 31922.85}{148^2}$

= 15.6 ohms.

O. K. See page 143

Length of Armature

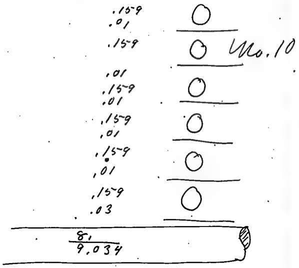
33 $\frac{3}{4}$"

Diam. of " 26."46

" " poles 27.322

Length of cores 4ft 7"

Diam. of cores 8"



Mean diam 9.034
3.1416
54204
9034
36136
9034
27102
Each turn 28.38~~72144~~

159)54.000(340
477
630
636

340 turns in a layer
2040
4080 turns on a magnet
= 9649.2 feet
and for three magnets
28948
28948 × ~~1573~~ .054353 = 1573 lbs.

Thickness of discs .065
" " insulation .020

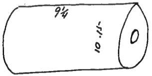
See page 141 for length of
wire = 31922.85 feet.

31922.85 × .066303
= 2117 lbs.

For the Buckeye
With 6 layers of No. 10
wire the no. turns in
each ~~layer~~ magnet = 2040
Total length = 28050 feet
Resis = 16.~~62~~ 7 ohms.
16.48
Weight
28050 × .054353 = 1530 lbs.

Steam boat dynamos.

The medium sized machine having a resistance of $\frac{14}{100}$ ohms has an armature of the dimensions outside of wire



Circumference = 31.887"
Radiating surface of face = 295 sq. in.

With 50 lamps of 115 ohms resis. the joint resis. is $\frac{115}{50}$ = 2.3 ohms and internal resis. is .14 ohms. With 110 volts outside the drop inside

will be 6.7 volts

Total energy lost in armature

$\frac{6.7^2}{.14} \times 44.3 = 14205$ ft. lbs.

Of this energy half is radiated as heat from the cylindrical surface

7102.5 ft. lbs. from 295 sq. in. of surface

= 24.1 ft. lbs. from each square inch.

The resistance on the face will be $\frac{7}{100}$ ohm, and of each end $\frac{3\frac{1}{2}}{100}$ ohm, with a radiating surface but 1/4 the cyl. surface.

In South American dynamo
The length of each rod is

$\frac{14.158+14.197}{2} = 14.178''$

The no. of commutators is 75 and the resistance of one side is

$$R = \frac{10.64 \times \frac{14.178}{12} \times 75}{\frac{\left(\frac{.192+.183}{2}\right).2}{.0000007854}}$$ See page 27

$= .019747$ ohms.

and for both sides a total resistance of

$= .0098735$ ohms.

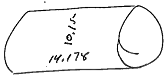
With x lamps (B. 16) with $\frac{115}{4}$ ohms resis. the total outside resis. will be $\frac{115}{4x}$.

The B, 16 lamps require 55 volts - For the regular A, 16 requires a certain amount of energy expressed by $\frac{V^2}{R}$ and in the case of the B. 16 by making E.M.F. = $\frac{V}{2}$ and Resis. = $\frac{R}{4}$ we have

$$\frac{\left(\frac{V}{2}\right)^2}{\frac{R}{4}} = \frac{V^2}{R} = \text{same}$$

energy as before.

The armature is



Circum = 31.887

Radiating surface 452.1 sq. in.

The outside resistance being $\frac{115}{4x}$ on 55 volts, the drop

in armature face will be

$$\frac{55 \times .0098735 \times 4x}{115}$$

and the energy developed will be

$$\frac{\left(\frac{55 \times .0098735 \times 4x}{115}\right)^2}{.0098735} \times 44.3$$

$$= \overset{1.601}{\cancel{1662122}} x^2$$

To obtain the same radiation per unit surface as before namely 24.1 ft. lb. per sq. in. we have

$$24.1 \times 452.1 = \overset{1.601}{\cancel{1662122}} x^2$$

$$x^2 = 6805$$

$$x = 83 \text{ lamps.}$$

Therefore in respect to radiating surface the machine is ample

With 50 lamps of $\frac{115}{4}$ ohms each the fall is 55 volts on $\frac{115}{200}$ ohms, suppose also 4 per cent of this fall on conductors = 2.2 volts, then assume the resistance of the end discs as equal to that of the armature face, which will be ample to make up for increased resistance due to connections, the total armature resistance will be

$$.0098735 \times 2$$
$$= .0197470 \text{ ohms.}$$

And the fall will be

$$\frac{55 \times .01975 \times 200}{115} = 1.9 \text{ ~~ohms~~ volts.}$$

The total required E.M.F. will be 59.1 and as contingency for polarizing make it 60 volts.

By the curve which is taken as a basis of calculation the product of the current by the no. of turns should be 4700 and the value of 1 ft. of cutting wire at 1000 ft. per minute should equal .24 volts.

The face of magnet being 9.5" and 75 commutators single wound, the entire length of cutting conductor is 59.375 feet

The diam of core of armature is 9.7 and let 1200 revo. be assume, which will give a cutting speed of 3047.35 feet per m.

$59.375 \times 3.04735 =$

$= 180.9364$

Volts required

$60 \div 180.9364$

$= .33161$ volts per foot at 1000 ft. per min. are required.

To attain this the product of the current by the turns must be ~~be~~ increased in like ratio

$.24 : .33161 :: 4700 :$

$= 6494$

In the case of the medium machine from which the experimental data were determined the product 4700 was obtained on a core 36" long and to

obtain 6494 in like pro-
portion we have

4700 : 6494 :: 36 :

Omit.

= 50"

To which add 1" for washers.

= 51"

= 4ft 3"

Instead of increasing by length
let the increase be by diameter
also, the cores were 6" diam.
We have therefore

$$\frac{6^2 \times 36 \times 6494}{4700} = 1792$$

and if 6.5" diam.

$$\frac{1792}{(6.5)^2} = 42.4$$

which increase to 43" for
washers and make the
available length = 42"

Instead of 55 Volts on
magnet assume but 75%
= 41 Volts

If R is magnet resis.
Current is $\frac{41}{R}$

And T = no. turns

$$\frac{41 T}{R} = 6494$$

$$\frac{T}{R} = 158.4$$

Assume 40 ohms
Then
$T = 6336$

With No. 17 B. W. G. and double cotton $\frac{15}{1000}$ insulation the total diam. = .058 + .015
= .073
and turns in one layer
= 42" ÷ .073 = 575

575
12
6900

6336 ÷ 575
= 11 turns or
5.5 to each core

See page 51

With six layers and
taking account of the
insulation we have
12650 feet and resis.
of 40 ohms.
and weight
= .010183 × 12650
= 128.8 lbs. of copper.
The product of the turns
by 41 and division by
40 ohm will give
6900 which is more
than required, but the
nearest by regular B.W. Gauge

When but few lamps are
on the full sixty volts
may be considered as outside

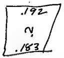
With 100 lamp machine
assume capacity for 125 lamps.
From page 153 the capacity
of 50 light machine is in
reality 83 lights.
and now this has to be in-
creased to 125 lamps.
The cross-section of arma-
ture wire should increase
in like proportion

And its dimensions be
in the ratio of the square
roots. as $\sqrt{83} : \sqrt{125}$

$9.11 : 11.18$

$1 : 1{\cdot}23$

From page 27 the dimensions of the rod for the 50 light machine will be



and this should be increased in ratio of 1 to 1.23.

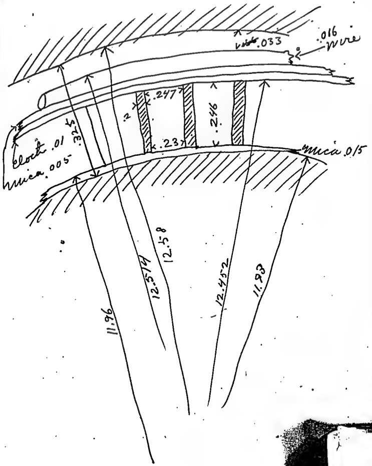
If the diam. 9.7" is increased in same ratio it becomes 11.93. Let the insulation under the rods be .015"

Depth of rods .2 × 1.23 = .246"

Cloth .01"

Mica .005"

Copper Discs $\frac{28}{1000}$"
Insulating paper $\frac{11}{1000}$"



The distance of field from armature core is

=,325

and at this distance 1 foot of cutting wire at 1000 ft. per minute = ,22 Volt | Should be ,2345 gives better margin

and product of current by turns will be as determined by diagram = 5948

add 5 = 6100

With 125 lamps of $\frac{115}{4}$ ohms each, the total will be

$\frac{115}{500} = ,23$ ohms.

At the same cutting
speed as dynamo D
the revolutions per minute
will be

$$\frac{9.7 \times 1200}{11.93} = 975 \text{ revs.}$$

Cutting speed
= 3045.2 feet

Value of 1 foot at 1000 feet
=.22 volts
Value at 3045.2 ft. per m.

3.045.2 × .22
=.669944

To give 60 volts it requires

$$\frac{60}{.669944} = 89.6 \text{ feet of}$$

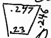
cutting conductor.

With 75 commutators
this will give the required length of field

$$\frac{89.6 \times 12}{75} = 14\tfrac{1}{2}'' \text{ approx.}$$

slightly excessive.

Cutting wire 90.6 feet



$\left(\frac{.247+.23}{2}\right).246 = .058671$ sq. in.

Resistance = $\frac{90.6 \times 8.357}{58671}$

= .0129 ohms.

Resis. total
= .00645 ohms.

To the length of field (14.5") must be added 4.678" for extra length of rods to the discs = 19.178"

This increases resistance

in the ratio of

$14.5 : 19.178 :: .00645$

Resis. = .00853

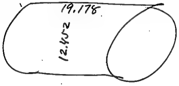
From page 175 joint resis. of 125 lamps is .23 ohm with a fall of 55 volts.

On the armature of .00852 ohm the fall will be

$$\frac{.00852}{.23} \times 55 = 2.04 \text{ Volts.}$$

Total foot-lbs. lost on armature face $= \dfrac{2.04^2 \times 44.3}{.00852}$

$= 21613$ ft. lbs.



Radiating surface
$= 750$ sq. in.

$\frac{21613}{750} = 29$ ft. lb.

With 100 lamps this
would be reduced $\frac{1}{5}$
or slightly more than
23 ft. lb. per sq. in.
which agrees with that
for the common medium
machine, See page 147.

As only a product of 6100 of current by turns is required by ~~using the same core as with dynamo D and the same number of turns and layers.~~

The field is increased in length from 9 1/4 to 14.1/2 and the core should be increased in like proportion

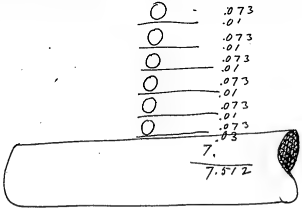
$$\frac{6^2 \times 36 \times 14.5}{9.25} = 2032$$

If 7" diam

length $\frac{2032}{7^2} =$ 42" effective length

and 1" for fibre washers

= 43" total length



Mean diameter 7.512

Circumference 23."6.

573 turns to a layer

Total 6876 turns, abundance in excess.

Total length = 13522.8 feet

$$\text{Resistance} = \frac{10.64 \times 13522.8}{58^2}$$

$$= 42.8 \text{ ohms.}$$

If we suppose the E.M.F.

$$
\begin{array}{r}
13522.8 \\
\underline{.010183} \\
405684 \\
1081824 \\
135228 \\
\underline{135228} \\
137.7
\end{array}
$$

to be only the same the
Current will be one ...
and product by turns will
be 6876 which is
ample as only
6100 was required.

Weight = 13522.8 X .010183 = 137.7 lbs.
of copper on Magnets.

Shaft. 2¼" steel.

F

With 200 light dynamo, the capacity should be at least 250 lights.

With 250 lights from page 169 the ratio of increase of rods should be

$\sqrt{83} : \sqrt{250}$

$9.11 : 15.8$

$1 : 1.75$

The rods for 50 light are

and depth should increase to .35

Increase armature in
same proportion

9.7×1.75

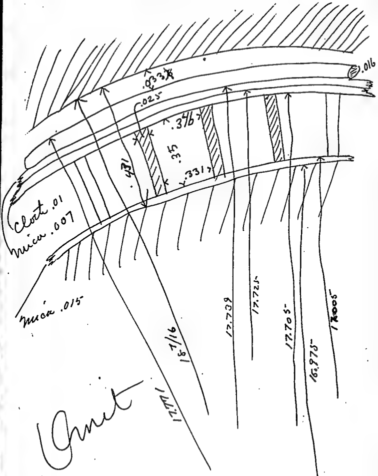
$= 16.975''$ diam.

$.1200 \div 1.75$

$= 700$ revolutions.

At 700 revs. the cutting speed
is $\frac{700 \times 16.975 \times 3.1416}{12}$

$= 3111$ ft. per min.



.016
.033
.025
.316
.35
.431
.331
Cloth .01
mica .007
mica .015
18 1/16
17.771
17.739
17.725
17.705
16.975
17.005
Unit

With a space equal
to .431" the value of 1 ft
cutting at a speed of
1000 feet per m. is

= .223 Volts.
and product of turns by current = 5900
Allow for a total fall of
65 Volts.

The length of conductor
is $\frac{65}{3.111 \times .223}$

= 94 feet

Which will be made
100 feet. or 1200 inches
$\frac{1200}{75}$ = 16 inches for
cutting length of armature

May 14. 1881.

With plates $\frac{42}{1000}$ thick and paper insulation of $\frac{15}{1000}$ with 75 plates the thickness will be 4.275" and the total length of rods will average $16 + 4.5 = 20.5''$

The resistance of the armature face as made up of these rods is

$$= \frac{75 \times \overset{20.5}{\cancel{1.333}} \times 8.357}{12 \times 2 \times \left(\frac{.346 + .831}{2}\right).35 \times 1000000}$$

$$= \frac{1284.88875}{2843400}$$

$$= .00452$$

With 250 B-16 lamps the external resistance is $\frac{115}{4 \times 250}$

$= ,115$ ohms.

With 55 volts fall on ,115 ohm there will be within the armature a fall of $\frac{,0045}{,115} \times 55$ volts

$= 2,152$ volts.

The energy developed in the face of the armature in the form of heat is $\frac{\overline{2,152}^2 \times 443}{,0045} = 45580$ ft-lbs. per minute.

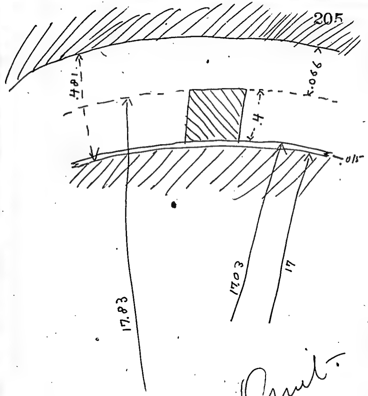
The radiating surface

b $3.1416 \times 17.7 \times 20.5$

$= 1141$ sq. in.

which gives 40 ft. lb. per sq. in. which is too great.

If we make the ratio of change of rods in similar dynamos as 1 to 2 instead of 1 to 1.75 the depth becomes .4 and assume diameter as 17" then the following diagram



Omit.

Space .52
1 ft at 1000 ft = .2125

Space, 275
1 ft at 1000 ft = .24

.52
.275
.245

.24
.2125
.0275

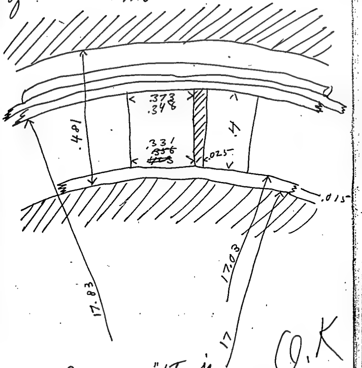
.481
.275
.206

.245 : .206 :: .0275 :
= .0231

The value for a space
of .481"
1 ft at 1000 ft = .2169
at 750 revs. per
m. this requires 90 ft.
cutting and 97 at 700
feet. If we assume
100 ft. or 1200 inches it
will require 16" length

of armature and add

10 % excess we have a length
of 17.6"



O.K

Plates $\frac{42}{1000}$" thick
Paper insulation $\frac{15}{1000}$"
75 discs

The cross section is
.1458 sq. in.
and total length of
rods 22.2 inches

$$\text{Resis} = \frac{75 \times 22.2 \times 8.357}{12 \times 2 \times 145800}$$

$= .004$ ohms.

The face of E.M.F. in face of armature is 1.91 Volts
and energy

$$\frac{1.91^2 \times 44.3}{.004} = 40402 \text{ ft. lbs.}$$

Radiating surface

$= 3.1416 \times 17 \times 22.2$

$= 1186$ sq. in.

Heat radiated from surface of 1 sq. in. = 34 ft. lbs.

With 250 lamps are required (6 per H.P.)

42 H.P.

Suppose 250 H.P.
or 1 H.P. per lamp

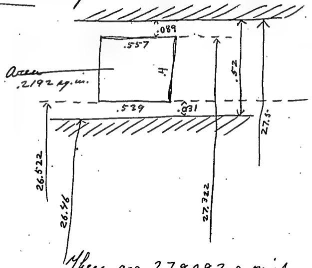
700)250
2.06).3543
.172

3" shaft of steel.

Make it 3 1/4"

Clarke, July 18, 1881

C dynamo.



There are 279093 c. mils in the above conductor

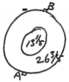
= 15.6 No. 10 B.W.G. wires.

$$R = \frac{10.33 \times 42.7 \times 73}{12 \times 279093}$$

= .00961 divide by 2

= .0048 ohms is the resistance of entire rods there being 146 each 42.7" long and 73 commutators.

The copper discs are of following dimensions



.065" thick

The area is 546.35 − 135.3
= 411.05
and multiply by thickness
= 411.05 × .065
= 26.71825 cu. inches.

Let us suppose as a most unfavorable condition that the entire amount is concentrated in the outside circumference and since the current passes from A to B two ways that the plates is folded in itself.
Half the circumference = 41.43"
and area of copper rod of this length is 26.71825 ÷ 41.43
= .6449 sq. in.

The circular mils =

$.6449 \div .0000007854$

$= 821110$

Resis. of 73 of these is

$$R = \frac{10.33 \times 41.43 \times 73}{12 \times 821110}$$

$R = .00311$

and $\div 2 = .001555$ ohms.

This must be added to the resis. of 73 rods =

$.00961 + .00311$

$= .01272$ ~~and ÷ 2 = gi~~ and if

(as is the case) multiple arced with another

$R = .00636$

This is the most unfavorable showing possible for the discs of copper.

Clarke July 18, 1881.

The diam. assume as 26.5"
The circumference will be
6.937 feet and travel at
350 revo. per minute is
2427 feet.
The strain on circumference
for 150 H.P. is 2040 lbs.
Divide this between 176 bars
= 11.2 lbs. per bar, or
5.6 lbs. on each lug.

Each bar is 42.7" long
and cross-section of 279093 c. mils
Weight = $\frac{42.7''}{12} \times 279093 \times .00003027$
= 3 lbs.

Centrifugal force

$$= \frac{3 \times \left(\frac{2427}{60}\right)^2}{\frac{26.5}{2 \times 12} \times 32.2}$$

= 138 lbs.

If supported by a strap in the centre the centrifugal force of half a bar will be 69 lbs. which puts a strain of 34.5 lbs. on the lug.

Resistance coils for
external circuit of dynamo C.
The work required will be
150 H.P. = 4950000 ft. lbs.

$$\frac{110^2 \times 44.3}{R} = 4950000$$

$$R = .108 \text{ ohm}.$$

$4950000 \div 772$

= 6412 units of heat

If water goes in at 60° and
out at 120° each pound of
water takes 60 units per
minute and for 6412 units
it takes 107 lbs. of water
per minute = $107 \div 8.3$

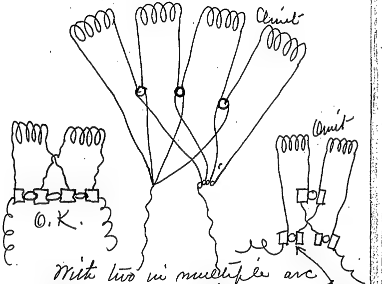
= 13 gallons.

With 1300 feet of No. 15 B.W.G
$= \frac{72}{1000}$" in each barrel the
resistance will be
Weighs .0157 lbs. per foot.

$R = \frac{10.64 \times 1300}{5784}$

$R = 2.67$ ohms

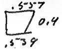
which will be made shorter to give 2.5 ohms.



With two in multiple arc the resistance will be .625 ohms

$.625 \div .108 = 6$ barrels are required.

A No. 10 B.W.G. wire has cross section of .0141 sq. in.
and two of the armature rods



.4384 sq. in.

= 31 No. 10 wire.

18 wires will be sufficient and 6 barrels being required 3 strands to each barrel.

Mar 18. 1881.

From page 275 the weight of the copper rods is 435 lbs. and radius 13.46" = 1.122 feet

The value for centrifugal force is $C' = \frac{4\pi^2}{g} . w . r . n^2$.

log 4	=	0.602060	
$(3.1412)^2$	=	.994302	$= (0.497151)2$
w	=	2.638489	
r	=	0.049993	
$\frac{(5.83)^2}{2}$ ~~(3.70)~~ $(n)^2$	=	1.531338	$= (0.765669)2$
		5.871.6182	
$g = 32.167$	=	1.507410	
		4.308772	

~~733600~~

20360.

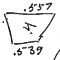
The aggregate pull is 20360 lbs. and half is 10180 lbs.

but this pressure is on the

circumference and should
be changed to diameter
Ratio
3.1416 : 1 :: 20360 :
= 6480 lbs.
and $\frac{1}{2}$ = 3240 lbs. is
the bursting strain on
the bands.

Heat developed in dynamo C.

Length of rods 42.7"



Cross section

$$\left(\frac{.557+.539}{2}\right).4 = .2192 \text{ sq. in}$$

$= 219200$ sq. mils.

Resis in 73 rods

$$= \frac{8.357 \times 73 \times 42.7}{12 \times 219200}$$

$= .00994$ ohms

and the resistance of armature face for an equal number in multiple arc

$= .00497$ ohms

With 1000 lamps (A.16) the joint external resistance will be .115 ohms.

and with 118 Volts external the external horse-power

772

developed will be

$$\frac{110^2}{.115} \times 44.3 = 4661139 \text{ ft-lb.}$$

$$= 141 \text{ H.P.}$$

The fall of E.M.F. within the armature will be

$$\frac{.00497}{.115} \times 110 = 4.754 \text{ volts}$$

The loss of energy in face of armature will be

$$\frac{4.754^2 \times 44.3}{.00497} = 201442 \text{ ft-lb.}$$

$$= 6.1 \text{ H.P.}$$

No. sq. in. in radiating cyl. face $= 27.3 \times 3.1416 \times 42.7$

$$= 3662 \text{ sq. in.}$$

An amount of heat radiated per sq. inch

$$= \frac{201442}{3662} = 55 \text{ ft-lbs.}$$

May 3, 1881.

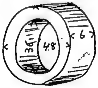
Armington and Sims Fly Wheel
Comparison of the energy with the energy of dynamo.

Since in the two cases the angular velocity is the same, in the formula for living force

$$L = \Sigma(mr^2)\theta^2$$

The angular velocity θ may be omitted and the comparison is simply one of inertia moments $\Sigma(mr^2)$

The fly wheel is of the following dimensions



The moment of inertia is

$$K = M \frac{r'^2 + r^2}{2}$$

$$r^2 = \frac{\cancel{36}}{18}^2. \qquad r'^2 = \frac{\cancel{48}}{24}^2.$$

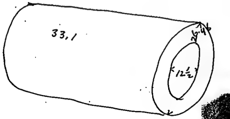
$$M = \frac{(1809.6 - 1017.9) \times 6 \times 450}{1728}$$

$$M = 1237 \text{ lbs.}$$

$$K = 1237 \times \overset{450}{\cancel{1800}}$$

$$K = \overset{\cancel{2226600}}{556650}$$

In the armature we have in thin iron plates and thick plates the equivalent of a wrought iron cylinder of the following dimensions



$$M = \frac{(551.5 - 122.72) \times 33.1 \times 485}{1728}$$

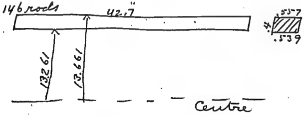
$M = 3984$ lbs.

$\bar{r}'^2 = \cancel{26.46}^2 \; 13.23$ $\qquad r^2 = \cancel{12.5}^2 \; 6.25$

$K = 3984 \times \cancel{428.19} \; 107.0475$

$K = \cancel{1705909} \; 426477.25$

The copper rods form a cylinder of the following size for rods



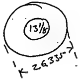
$$M = \frac{\frac{.557 + .539}{2} \times .4 \times 42.7 \times 146 \times 550}{1728}$$

$= 435$ lbs. $\quad \bar{r}'^2 = 13.66^2 \;\big|\; \bar{r}^2 = 13.26^2$

$K = 435 \times 181.2$

$K = 78822$

There are 146 copper discs $\frac{65}{1000}$" thick and following dimensions



$$M = \frac{(543.25 - 135.3) \times .065 \times 146 \times 550}{1728}$$

$M = 1231$ lbs.

$\overline{r'^2} = \overline{13.1625}^2 \qquad \overline{r^2} = \overline{6.56}^2$

$K = 1231 \times 108$

$K = 132948$

The $\Sigma(K) = 426477 + 78822 + 132948$

$\Sigma(K) = 638247$

[ITEM FOUND IN BOOK]

42.7 length of bars.
33.75 Useful length.

33.75) 8.95 (~~37.7%~~

26.5%

Ratio of ~~useless~~ to useful length of bar.

Resis. of 42.7" = .0048 ohms.

Resis of 11 1/4" = .001265 ohms

Measured total resistance was .0085 ohms

Total Resis. with additional length of bars of 33 1/3 % on face = .009765 ohms.

Gain in E.M.F. of 33 1/3 %

Additional resis. of 14.9%

With .15 ohms external resis. the E.M.F. was 85 volts
With internal resis. of .0085 this gives a drop in the machine of 4.82 Volts.

2

If total is 85 + 4.82
= 89.82 volts
and we increase it 1/3
Total E.M.F.
= ~~119.76 volts~~

With external resistance of .15 ohms and internal resistance of .009765 ohms the drop in armature will be 7.7963 ohms.

External E.M.F.
= 111.9637 ohms.

The new length of bars is 53.95".
Available length is 45"
Ratio of useless to useful
19.9 %.

[ITEM FOUND IN BOOK]

3

With 4 calorimeters the resis. external is .15 and with five calorimeters will be .12 ohms.

With .12 ohms external resis. the E.M.F. was 85 volts.

With internal resis. of .0085 this gives a drop in the machine of 6.02

If total is 85 + 6.02
= 91.02 ohms.
and increase is 1/3
Total E.M.F.
= 121.36

4

With external resistance of .12 ohms and internal resistance of .009765 ohms the drop in armature will be ~~9.876~~ 9.814

External E.M.F.
~~112.484~~ 112.422

The resis. of armature was measured at 82°F. to be .0085

The end discs of copper will not be considered as rising in temperature.

The resis. of bars at 60°F. is calculated to be .0048 ohms.

At 82° F. it will be .0048 × 1.0472

= .005027 ohms.

The measured resis. being .0085 the resis. due to copper discs and connections is .003473 ohms.

If the temp. be increased in the rods to 130° the resis. will be $.0048 \times \frac{.065 \times 70}{30} + 1$

= .00553 ohms.

Total internal resis. will be = .009 ohms.

With addition of $\frac{1}{3}$ to the available length of bars. the resis. of bars at 60°F. is ~~$.0048 + \frac{.0048}{3}$~~

= .006065 ohms.

The resis. at 130

.006065 × 1.1517

= .006985 ohms.

Total resistance

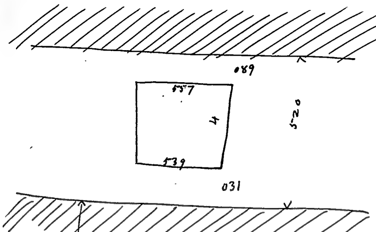
.006985 + .003473

= .01046 ohms.

With total E.M.F. = 121.36

The internal drop of E.M.F. = 9.76

Total External = 111.6



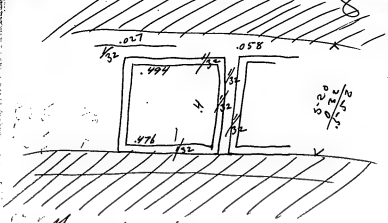
Cross-Section of bars of dynamo C as at present.

Cross-section .2192 sq. in.

If we take 1/32" off each side = .0625 the Cross-section = .1942

Which shows an increase of resis. in armature face of 13%.

[ITEM FOUND IN BOOK]



From page 6 the resistance of the bars at 60°F is .006065 and this will be increased by 130°F

= .00685

And at 130° F =

.00685 × 1.1517

= .00789 ohm.

Total =

.00789 + .003473

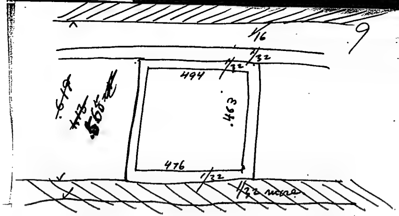
= .011363 ohms.

With total E.M.F. = 121.36

Internal drop. 10.5 volts

External 110.86

9



If 1/16 is added to the depth the cross section is .2245 sq. in. which is a decrease of resis. of 2 1/2 %

.619
.03125
.65025
.52
1.13

1/32

3/32

[ITEM FOUND IN BOOK]

.15 ohms for 4 barrels
4
.60 ohms for 1 barrel.

130 Volts total

.009765
130

.609765) 1.2694500 (2.1 ohms
1219530 x
499200   1 barrel.

.309765) 1.2694500 (4.1 ohm
1239060
303900   2 barrels.

.209765) 1.2694500 (6.05 ohms
1258590 x
1086000   3 barrels.

.159765) 1.2694500 (7.9 ohms
1118355 x
1510950   4 barrels.

.129765) 1.2694500 (9.8 ohm.
1167885 x
1015650   5 barrel.

130
2.1
127.9 ohms 1 barrel

130
4.1
125.9 ohms 2 barrels

130
6.05
123.95 ohms 3 barrels.

130
7.9
122.1 ohms. 4 barrels.

130
9.8
120.2 ohms 5 barrels.

3.9 7.4 9.4 7.0

2 1.95 1.85 1.9

127.9 125.9 123.95 122.1 120.2

95.1% 94.5 87.1 77.7 70.7

11 11 13 10

130 119 108 95 85

127.9 125.9 123.95 122.1 120.2

[ITEM FOUND IN BOOK]

130) 127.9 (.984
1170
1090
1040
500

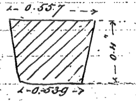
125.9) 119.00 (94.5
11331
5690
5036
6540

123.95) 108.000 (87.1
99160
88400
86765
16350

122.1) 95.000 (.777
85477
9530

120.2) 85.000 (.707
84.14
8600

OFFICE OF THE
EDISON ELECTRIC LI
65, 5th AV
NEW YOR.



73 rods 42.660" long.
72 rods 42.745" long.
1 rod 36.52 long.

Armator Rods of Dynamo C.

Menlo Park Notebook #215 [N-81-02-04]

This notebook covers the period February 1881. The entries are by Francis Jehl and consist of calculations relating to resistances of experimental lamps. The label on the front cover is marked "Experimental Lamps 2," "1881," and "Francis Jehl." There is an index on the inside front cover. The book contains 280 numbered pages.

Index.

Feb. 4, 1881.
Order 130 – R 190
91 V – 18

Volts 108.67 48 C

Res. 18840
11000 | R

200 / 19940 / 99
1800
1940
1800
140

119
100
19 Ohms inserted.

130
100

109 / 13000 / 119
109
210
109
1010
981
29

Feb. 4 1881.
Order 130 – R 230
100 V – 12

Volts 122.85 V

48 C

Res 18840 R
6000

200 / 24840 / 124
200
484
400
840
800
40

130
124
520
260
130

131
124
7 Ohms inserted.

123 / 16120 / 131
123
382
369
130
123
7

Feb. 4, 1881
Order 156 – R 385
No. 1

Volts 118.12 V

48 C

Res 18840
2400 R

200 / 21240 / 106
200
1240
1200
40

130
106
780
130

117
106
11 Ohms inserted.

118 / 13780 / 116
118
198
118
880
708
92

Feb. 4, 1881.
Order 37 – R225
No. 5

Volts 118.8

48 C

Res 18840
2300 R

200/21140
106

130
106
780

116
10.6
10 Ohms inserted

130
119/13780/115
119
188
119
690
595
95

Feb. 4 1881.
Order 156 – R380
No. 2

118.12 V

48 C

18840
1500 R

200/20340/101 R
200
340
200
140

112
101
11 Ohms inserted.

130
102
260
130
119/13260/111
119
136
119
170
119
51

Feb. 4, 1881.
Order 37—R200
No. 6

116.77 v

48 C

~~118840~~

18840 R
1400 R

200/20240/101
200
240
200
40

112
101
11 Ohms inserted.

130
101
130
130

117/13130/112
117
143
117
260
234
26

Feb. 4, 1881.
Order 37—R230
No. 4

118.12 v

18840 R
3400 R

48 C

200/22240/111
200
224
200
240
200
40

122
111
11 Ohms inserted.

130
111
130
130
130

118/14430/122
118
263
236
270
236
34

Feb. 4, 1881.
Order 44 - R 280.

Volts 114.75

48 C

Res. 18840
3200 R

200/22140/110
200
214
200
140

126
111
15 Ohms inserted.

130
111
130
130
130
115/14430/125
115
293
230
630
575
55

Feb. 4 1881.
Order 156 - R 390
No. 3

Volts 116.10

48 C

Res. 18840
1200 R

200/20040/100
200
40

112
100
12 Ohms inserted.

130
100
116/13000/112
116
140
116
240
232
8

Feb. 4, 1881.
Order 37-R200
No. 7

Volts N. Y. vacuum.

Res

Feb. 4, 1881.
Order 37-R195
No. 3

Volts. ~~100~~ 111.0.4

Res. 18840 48C
800 R

200/19640/98
1800
1640
1600
40

130
98
1040
1170
111/12740/114
111
164
111
530
444
86

115
98
17 Ohms inserted.

Feb: 4, 1881.
Order 45 – R233
92 1/2 V – H

109.35 V

48C

18840 R
1400
200/20240/101
200
240
200
40

121
101
20 Ohms inserted.

130
101
130

130
109)13130/120
109
223
218
50

Feb: 4, 1881.
Order 156 – R365
No: 9

116.10 V

48C

18840 R
1500
200/20340/101
200
340
200
140

114
102
12 Ohms inserted.

130
102
260

130
116)13260/114
116
166
116
500
464
36

Feb. 4, 1881.
Order 156 - R375
No. 4

111,34 V

1884.0
1500 R

200/20340/101

200

340

200

140

48 C

18 Ohms inserted.

Feb. 4, 1881.
Order 37 - R205
No. 8

111,34 V

48 C

18840 R
1500 R

200/20340/101

200

340

200

140

120
102

18 Ohms inserted.

130
102

260

130

111/13260/119

111

216

111

1050

999

51

Feb. 4, 1881.
Order 37 - R 205
No. 2

111.24 V

46 C

18840
1700 R

200 / 20540 / 102
200
540
400
140

121
103
18 Ohms inserted.

130
103
390
130
111 / 13390 / 120
111
229
222
90

Feb. 4, 1881.
Order 155 -
11

57.33 V

46 C

6279 R
1300

200 / 7579 / 37
600
1579
1400
179

86
38
48 Ohms inserted.

130
38
1040
390
57 / 4940 / 86
456
380
342
38

Feb. 4, 1881.
Order 45-R262
113½ V-22

130 V

46 R

$$\begin{array}{r} 25127 \\ 3000\ R \\ \hline 200)\overline{28127}/140 \\ \underline{200} \\ 812 \\ \underline{800} \\ 127 \end{array}$$

$$\begin{array}{r} 130 \\ \underline{140} \\ 5200 \\ \underline{130} \\ 130)\overline{18200}/140 \\ \underline{130} \\ 520 \\ \underline{520} \\ 0 \end{array}$$

140
0

Feb. 4, 1881.
Order 156-R410
No. 8

111.34 V

$$\begin{array}{r} 18840\ R \\ 2200\ R \\ \hline 200)\overline{21040}/105 \\ \underline{200} \\ 10.40 \\ \underline{1000} \\ 40 \end{array}$$

$$\begin{array}{r} 123 \\ \underline{105} \\ 18 \end{array}$$ Ohms inserted.

$$\begin{array}{r} 130 \\ \underline{105} \\ 650 \\ 130 \\ \hline 111)\overline{13650}/122 \\ \underline{111} \\ 255 \\ \underline{222} \\ 330 \\ \underline{222} \\ 108 \end{array}$$

Feb. 4, 1881.
Order 156 — R 350
No. 5

108.5

18840
500 | R
200 / 19340 / 96
1800
1340
1200
140

115
97
18 Ohms inserted

130
96
780
1170
109 / 12480 / 114
109
158
109
490
436
54

Feb. 4, 1881.
Order 37 — R 230
No. 1

114.75 V

18840 R
3200 R
200 / 22040 / 110
200
204
200
40

14 Ohms inserted

130
110
1300
130
115 / 14300 / 124
115
280
230
500
460
40

124
110
14

Feb. 4, 1881.
Order 45 - R 278
No. 1

Feb. 4, 1881.
Order 156 - R 365
No. 7

114.75 V

18840 R
3200 R

200 / 22040 / 110
200
204
200
40

14 ohms wont

124
110
14

115 : 130 :: 110

130
110
13200
130
115) 14300 (124
115
280
230
500

Feb. 4, 1881.
Order 156 – R 340
No. 6

111.345

1840
800 R

200)19640/98. 17 ohms insert
1800
1640
1600
40

111 : 130 :: 98 : 98 : x

130
98

1040
1170

111)12740(114
111
164
111
530

115
98
17

$\frac{A \times R}{S} - R = 17$

Feb. 4, 1881.
Order 141 – R 295
10

Feb. 4, 1881.
Order 141 – R 295
12

30 @ at 130v
High R.

Feb. 4, 1881.
Order 141 – R 240
14

124.83v

18840 R
3600 R

200 / 22440 / 112
200
244
200
440
400
40

117
112
5 Ohms inserted

130
112
260
130
130

125 / 14560 / 116
125
206
125
810
750
60

Feb. 4, 1881.
Order 141—R 245
26 (A)

124.83 ℧

$$\begin{array}{r} 1884.0 \\ 3600 \\ \hline 200 \,)\, 22440 \\ \hline 112 \end{array}$$ R

—5 Ohms inserted

Feb. 4 1881.
Order 141—R 240
15

124.83 ℧

$$\begin{array}{r} 18840 \\ 3600 \\ \hline 200 \,)\, 22440\,(\,112 \\ 200 \\ \hline 244 \\ 200 \\ \hline 440 \end{array}$$ R

5 Ohms inserted

130 ✓

25127 R

130 ✓

25127
600 R

200) 25727 (123
200
572
400
727

Feb. 4 1881.
Order 141 — R 295
28

130 V

25127 R

Feb. 4 1881.
Order 141 — R 240 ( )
26 (B)

121.50 V

18840 R
3600 R

$$
\begin{array}{r}
200\,)\,22440\,(112 \\
200 \\
\hline
244 \\
200 \\
\hline
440 \\
400 \\
\hline
40
\end{array}
\qquad
\begin{array}{r}
119 \\
112 \\
\hline
7
\end{array}
$$

7 Ohms inserted.

$$
\begin{array}{r}
130 \\
112 \\
\hline
260 \\
130 \\
130 \\
\hline
14560
\end{array}
$$

$$
\begin{array}{r}
122\,)\,14560\,(119 \\
122 \\
\hline
236 \\
122 \\
\hline
1140 \\
1098 \\
\hline
44
\end{array}
$$

Feb. 4, 1881.
Order 141 – R 300
14

130 V

18840 R
9600
200 | 28440 | 142

Feb. 4, 1881.
Order 141 – R 280
18

126.90 V

18840 R
4600
200 / 23440 / 117
200
344
200
1440
1400
40

120
117
3 Ohms inserted.

130
117
910
130
130
127 / 15210 / 119
127
251
127
1240
1143
97

Feb. 4, 1881.
Order 141 — R 245
7

126.90 V

$$\frac{18840}{4600}$$ R = 3 Ohms inserted.

200 | 23 ~~440~~
117

Feb. 4, 1881.
Order 140 —
37

130 V

$$\frac{1884.0}{6100}$$ R

200 | 24 ~~94~~ 0
1 25

Feb. 4, 1881.
Order 141 – R 380
11

130 √

18840 R
8800

200 / 27340 / 136
200
734
600
1340
1200
140

130
137
910
390
130

130 / 17810 / 137
130
481
390
910
910

Feb. 4, 1881.
Order 140 – R
No. 2

124.83 √

18840 R
4800

200 / 23640 / 118
200
364
200
1640
1600
40

123
118
5 Ohms inserted

130
118
1040
130
130

125 / 15340 / 122
125
284
250
340
250
90

Feb. 4, 1881.
Order 140 - R 320
21

130 √

18840 R
6600
~~100~~ / ~~25440~~
127

Feb. 4, 1881.
Order 140
No. 7

126.22 √

18840 R
5300 R
200 / 24140 / 120
200
414.
400
140 125
120
5 Ohms inserted.
130
121
130
260
130
126 / 15730 / 125
126
313
252
610
610

Feb. 4, 1881.
Order 140 - R 360
23

130 ✓ 32 C

25127
4600

200 | 29727
148

R

N. G.

Feb. 4. 1881.
Order 140 - R 350
10

130 ✓

25127
3000

200 | 28127
140

R

Feb. 4, 1881.
Order 140
30

126.90

25127 R
300

200/25427/127
200
542
400
1427
1400
27

130
127
3 Ohms inserted

130
127
910
260
130
127/16510/130
127
381
381
0

Feb. 4, 1881.
Order 140
No. 31

123.52

18840 R
3800

200/22640/113
200
264
200
640
600
40

119
113
6 Ohms inserted

130
113
390
130
130
124/14690/118
124
229
124
1050
992
58

Feb. 4, 1881.
Order 140-R
No. 32

12622 ✓

18840 R
4800

200/ 23640 /118
200
364
200
1640
1600
40

118
122
6 Ohms inserted.

130
118
1040
130
130

126/ 15340 /121
126
274
252
220
126
94

Feb. 4 1881.
Order 140-R
No. 33

12420 ✓

18840 R
4100

200/ 22940 /114
200
294
200
940
800
140

121
115
6 Ohms inserted.

130
115
650
130
130

124/ 14950 /120
124
255
248
70

Feb. 4, 1881.
Order 140
No. 34

124.835

18840
4800 R

200/23640/118
200
364
200
1640
1600
40

123
118
5 Ohms inserted.

130
118
1040
130
130

125/15340/122
125
284
250
340
250
90

Feb. 4, 1881.
Order 140
No. 35

124.835

18840
4900 R

200/23740/118
200
374
200
1740
1600
140

124
118
6 Ohms inserted.

130
119
1170
130
130

125/15470/123
125
297
250
470
375
95

Feb. 4, 1881.
Order 140 –
No. 36

119.4 V

1.8840
4700 R

200/ 23540 /117
200
354
200
1540
1400
140

129
118
11 Ohms inserted

130
118
1040
130
130

119/ 15340 /128
119
344
238
1060
952
112

Feb. 4, 1881.
Order 140 – R 340
25

130. V

2512 / 500 R

at 38 C

W. S.

Feb. 4 1881.
Order 140-R 320
24

128.25 U

25.127
800 R

200)3312(16
200
1312
1200
112

17
16
1 Ohms inserted.

130
17
910
130
128)2210(17
128
930
896
34

Feb. 4 1881.
Order 140-R 345
29

122.85

18840
4200 R

200)23040(115
200
304
200
1040
1000
40

117
115
2 Ohms inserted.

130
115
650
130
130
128)14950(116
128
215
128
870
768
102

Feb. 4, 1881.
Order 140 $\frac{R}{1\,(B)}$ 335

130 V

$$\begin{array}{r} 18840 \\ 7500 \text{ R} \\ \hline 200 \,\big)\, 263\cancel{40} \\ \hline 131 \end{array}$$

Feb. 4, 1881.
Order 140
9

130 V

$$\begin{array}{r} 18840 \\ 5000 \text{ R} \\ \hline 200 \,\big)\, 238\cancel{40} \\ \hline 119 \text{ Ohms} \end{array}$$

Feb. 4, 1881.
Order 140 – R 310
16

130 V

18840
8000 R

200 / 26840 / 134
200
684
600
840
800
40

130
134
524
390
130
130 / 17424 / 134
130
442
390
524
520
4

Feb. 4, 1881.
Order 140 / (R)

121.50 V

18840
3500 R

200 / 22340 / 111
200
234
200
340
200
140

119
112
7 Ohms inserted.

130
112
260
130
130
122 / 14560 / 119
122
236
122
1140
1098
42

Feb. 5, 1881.
Order 39-R 335
No. 11

118,12V

1884.0
3800 R

200/22648/113
200
264
200
640
600
40

125
113
12 Ohms inserted.

130
113
390
130
130

118/14690/124
118
289
236
530
472
58

Feb. 5, 1881.
Order 39-R 296
No. 13

118,12V

18840
4100 R

200/22940/114
200
294
200
940
800
140

127
115
12 Ohms inserted.

130
115
650
130
130

118/14950/126
118
315
236
790
788
82

Feb. 5, 1881.
Order 39 - R 305
12

114.75 V

18840 R
3500 R

200/22340/111
200
234
200
340
200
140

127
112
15 Ohms inserted.

130
112
260
130
130

115/14560/126
115
306
230
760
690
70

Feb. 5, 1881.
Order 39 - R 310
21

114.75

18840 R
3500 R

200/22340/111
200
234
200
340
200
140

127
112
15 Ohms inserted

130
114
115/14560
127

Feb. 5, 1881.
Order 39 - R 295
20

114.75 V

18840 R
3900

200 / 22740 / 113
200
274
200
740
600
140

129
114
15 Ohms inserted.

130
114
520
138
130
115 / 14820 / 128
115
332
230
1020
920
100

Feb. 5, 1881.
Order 39 - R 325
2

121.50 V

18840
3900 R

200 / 22740 / 113
200
274
200
740
600
140

122
114
8 Ohms inserted.

130
114
122 / 14820
122

118,125

18840 R
4200

200)23040(115
200
304
200
1040
1000
40

127
115
12 Ohms inserted.

130
115
655
138
130

118)14955(126
118
315
236
795
708
87

118,125

18840 R
3300

200)22140(110
200
214
200
140

122
111
11 Ohms inserted.

130
111
130
133
130

118)14438(122
118
263
236
270
236
34

Feb. 5, 1881.
Order 39 - R 290
29

118.12 V

18840 R
3800 R

200 / 22640 / 113
200
264
200
640
600
40

125
113
12 Ohms inserted.

130
113
390
130
130

118 / 14690 / 124
118
289
236
530
472
58

Feb. 5, 1881.
Order 32 - R 280
103½ V - 4

122.17 V

18840 R
6200 R

200 / 25040 / 125
200
504
400
1040
1000
40

133
125
8 Ohms inserted.

130
125
650
260
130

122 / 16250 / 133
122
405
366
390
366
24

Feb. 5, 1881.
Order 32 – R 290
100 V – 7

118.80 V

18840
5200 R

200 / 24040 / 120
200
404
400
40
480
130
120
2600
130
119 / 15600 / 131
119
370
357
130
119
11

131
120
11 Ohms inserted.

Feb. 5, 1881.
Order 32 – R 280
105 V – 2

124.83 V

18840
7600 R

200 / 26440 / 132
200
644
600
440
400
40
480
130
132
260
390
130
125 / 17160 / 137
125
466
375
910
875
35

137
132
5 Ohms inserted.

Feb. 5, 1881.
Order 32 - R 280
105 V - 20 (A)

122.85 V

18840 R
5400

200 / 24240 / 121
200
424
400
240
48 C
40

130
121
130
260
130

128
121
7 Ohms inserted.

123 / 15730 / 127
123
343
246
970
861
109

Feb. 5 1881.
Order 32 - R 285
99 V - 18

118.12 V

18840
5900 R

200 / 24740 / 123
200
474
400
740 C
600
140
48

130
124
520
260
130

137
124
13 Ohms inserted.

118 / 16120 / 136
118
432
354
780
708
72

Feb. 5, 1881.
Order 32-R 298
103 V-13

121.50 V

18840
6200 R

25040

48 C

200/25040/125
200
504
400
1040
1000
40

130
125
5 Ohms inserted.

130
125
650
260
130
122/16250/133
122
405
366
390
366
24

Feb. 5, 1881.
Order 32-R
14

122.85 V

18840
7100 R

25940

48 C

200/25940/129
200
594
400
1940
1800
140

137
130
7 Ohms inserted.

130
120
3900
130
123/16900/137
123
460
369
910
861
49

Feb. 5, 1881.
Order 32 - R 295
96 V - 20 (B)

118.12 V

18840
5200 R

200 / 240 40 / 120
200
404
400
40

132
120
12

48 Ω Ohms inserted.

130
120
2600
130
118 / 15600 / 132
118
380
354
260
236
24

Feb. 5, 1881.
Order 32 - R 295
95½ V - 23

120.82 V

18840
5200 R

24040.

48 Ω

200 / 24040 / 120
200
404
400
40

129
120
9 Ohms inserted.

130
120
2600
130
121 / 15600 / 128
121
350
242
1080
968
112

Feb. 5, 1881.
Order 32-R 275
98 V - 21

117.45 V

18840
4700 R
23540

48 ℓ

200/23540/117
200
354
200
1540
1400
140

130
118
1040
130
130

131
118
13 Ohms inserted.

117/15340/131
117
364
351
130
117
13

Feb. 5, 1881.
Order 32-R 310
100½ V - 14

118.12 V

18840
5200 R
200/24040/120
200
404
400
40

48 ℓ

130
120
2600
130

132
120
12 Ohms inserted.

118)15600/132
118
380
354
260
236
24

Feb. 5, 1881.
Order 32 - R 315
102 V - 8

121.50 V

18840
7300 R

200/26140/130
200
614
600
45 140

131
130
3930
131

122/17030/139
122
483
366
1170
1098
72

140
131
9 Ohms inserted.

Feb. 5, 1881.
Order 32 - R 265
99 V - 25

118.12 V

18840
4500 R

200/23340/116.
200
334
200
1340
1200
48 140

130
117
910
130
130

118/15210/128
118
341
236
1050
944
106

129
117
12 Ohms inserted

Feb. 5, 1881.
Order 32-R 290
101½ V-9

118.12 V

18840
6500 R

200/25340/126
200
534
400
48

C 1340
1200
140

130
127
910
260
130
118/16510/139
118
471
354
1170
1062
108

140
127
13 Ohms inserted.

Feb. 5, 1881.
Order 32-R 275
100½ V-7

118.12 V

18840
5500 R
24340

48 C
200/24340/121
200
434
400
340
200
140
130
122
260
260
130
118/1586 0/134
118
406
354
520
472
48

134
122
12 Ohms inserted

Feb. 5, 1881.
Order 32-R 295
105 V-26

122.85 V

18840
7100 R

25940

48 C

200/25940/129
200
594
400
1940
1800
140

138
130
8 Ohms inserted.

130
130
3900
130
123/16900/137
123
460
369
910
861
49

Feb. 5, 1881.
Order 32-R 270
103 V-3

122.17 V

18840
6600 R

25440

48 C

200/25440/127
200
544
400
1440
1400
40

130
127
910
260
130
122/15510/127
122
331
244
870
854
16

Feb. 5, 1881.
Order 32 – R 295
106 V – 4

121.50 V

18840
7100 R
25940

48 C
200/25940/129
200
594
400
1940
1800
140

139
130
9 Ohms inserted.

130
130
3900
130
122/16900/138
122
470
366
1040
976
64

Feb. 5, 1881.
Order 32 – R 290
– 27

120.15 V

18840
5100 R

200/23940/119
200
394
200
1940
1800
140
48 C

130
120
2600
130
120/15600/130
120
360
360
0

130
120
10 Ohms inserted

Feb. 5, 1881.
Order 139-R450
High-1

130✓ 13 C

37687 | R
3000

200) 40687 (203
400
687
600
87

130
203
390
260
130) 26390 (203
260
390
390

Feb. 5, 1881.
Order 139-R420
High-5

Went up in the Phone room.

Feb. 5, 1881.
Order 139 - R 415
High - 2

130 V 25 C

31406 R
3000

200 / 34406 / 172
200
1440
1400
406
400
6

130
172
260
910
130

130 / 22360 / 172
130
936
910
260
260

Feb. 5, 1881.
Order 139 - R 410
High - 13

130 V 19 C

31406 R
4200

200 / 35606 / 1780
200
1560
1400
1600
1600 6

130
1780
10400
910
130

130 / 231400 / 1780
130
1014
910
1040
1040 0

Feb. 5, 1881.
Order 139 - R 400
10

130 ✓

16 C

31406
3200 R

200/34606/173
200
1460
1400
606
600
6

130
173
390
910
130
130/22490/173
130
949
910
390
390

Feb. 5, 1881.
Order 146 - R 275
No. 7

130 ✓

48 C

18840
5800 R

200/24640/123
200
464
400
640
600
40

123
130
3690
123
130/15990/123
130
299
260
390
390

Feb. 5, 1881.
Order 146 - R 270
No. 6

130 V 48 C

18840
6900 R

200 / 25740 / 128
200
574
400
1740
1600
140

130
129
1170
260
130
130 / 16770 / 129
130
377
260
1170
1170

Feb. 5, 1881.
Order 146 - R 290
No. 5

130 V

35 C

18840
7700 R

200 / 26540 / 132
200
654
600
540
400
140

130
133
390
390
130
130 / 17290 / 133
130
429
390
390
390

Feb. 5, 1881.
Order 146 - R 285
No. 4

130 √

18840
6100 R

200 / 24940 / 124
200
494
400
940
800
140

48

130
125
650
260
130

130 / 16250 / 125
130
325
260
650
650

Feb. 5, 1881.
Order 146 - R 280
No. 3

130 √ 38 C

18840
8200 R

200 / 27040 / 135
200
704
600
1040
1000
40

130
135
655
390
130

130 / 17550 / 135
130
455
390
650
650

Feb. 5, 1881.
Order 146-R 260
No. 2

126.90 ✓

48 C

18840
6500 R

200 / 25340 / 126
200
534
400
1340
1200
140

130
127
910
260
130

130
127
3 Ohms inserted.

127 / 16510 / 130
127
381
381
0

Feb. 5, 1881.
Order 146-R 265
No. 1

126.90 ✓

18840
6000 R

48 C

200 / 24840 / 124
200
484
400
840
800
40

130
124
520
260
130

127
124
3 Ohms inserted.

127 / 16120 / 126
127
342
254
880
762
118

Feb. 5, 1881.
Order 123 – R 300
112½ V – 16

busted Carbon.

Feb. 5, 1881.
Order 123 – R 310
118½ V – 28 *

1.30 V   20 C

25127
7000

200 / 32627 / 163
200
1262
1200
627
600
27

130
163
390
788
130

130 / 21190 / 163
130
819
780
390
390

Feb. 5, 1881.
Order 123 - R 315
115 V - 10

130 V 22 C

25127 R
6000

200/31127/155
200
1112
1000
1127
1000
127

130
156
780
650
130
130/20280/156
130
728
650
780
780

Feb. 5, 1881.
Order 123 - R 295
115½ V - 18

130 V 26 C

25127 R
3000

200/28127/140
200
812
800
127

130
141
130
520
130
130/18330/141
130
533
520
130
130

Feb. 5, 1881.
Order 123-R
115½ V-10 (B)

130 V 23 C

25127
5700 R

200) 30827 (154
200
1082
1000
827
800
27

130
154
520
650
130

130) 20020 (154
130
702
650
520
520

Feb. 5, 1881.
Order 124-R 255
100½ V-9

12150 V 48 C

18840
4000 R

200) 22840 (114
200
284
200
840
800
40

130
114
520
130
130

122) 14820 (121
122
262
244
180
122
58

122
114
8 Ohms inserted

Feb. 5, 1881.
Order-124-R 245
103½ V-20

122085 V

48 C

18840
3000 R

200 / 21840 / 109
200
1840
1800
40
130
109
1170
130
123 / 14170 / 115
123
187
123
640
615
25

115
109
6 Ohms inserted.

Feb. 5, 1881.
Order 124-R 245
103½ V-11

124183 V

18840 R
3000

48 C

200 / 21840 / 109
200
1840
1800
40
130
109
1170
130
125 / 14170 / 113
125
167
125
420
375
45

113
109
4 Ohms inserted.

Feb. 5, 1881.
Order 124 - R 275
108 1/2 V - 24

130 V   48 C

```
   18840
    6700 R

200 / 25540 / 127
      200
       554
       400
       1540
       1400
        140

   130
   128
  1040
  260
 130
130 / 16640 / 128
      130
       364
       260
       1040
       1040
```


Feb. 5, 1881.
Order 124 - R 280
112 1/2 V - 29

126.90 V

```
   18840 R     48 C
    6000 R

200 / 24840 / 124
      200
       484
       400
        840
        800
    130  40
    124
    520
   260
  130
127 / 16120 / 126
      127
       342
       254
        880
        762
        118
```

127
124
3 Ohms inserted.

Feb. 5, 1881.
Order 124 – R 230
98 V – 2

119.47 V 48 C

18840
1300
200 / 20140 / 10
200
140

130
11
130
130
119 / 1430 / 12
119
240
238
2

12
11
1 Ohm inserted.

Feb. 5, 1881.
Order 124 – R 250
99½ V – 12

119.47 V

18840
4200
200 / 23040 / 115
200
304
200
1040
1000
40

126
115
11 Ohms inserted.

130
115
650
130
130
119 / 14950 / 125
119
305
238
670
595
75

Feb. 5, 1881.
Order 124 - R 275
102½ V - 23

120.15 V

48 C

18840
5300 R

200/24140/120
200
414
400
140

130
121
130

260
130

120/15730/131
120
373
360
130
120
10

131
121
10 Ohms inserted.

Feb. 5, 1881.
Order 124 - R 290
101½ V - 15

120.82 V 48 C

18840
5300 R

200/24140/120
200
414
400
140

130
121
130

260
130

121/15730/130
121
363
363
0

130
121
9 Ohms inserted.

Feb. 5, 1881.
Order 124 – R 260
99½ V – 8

121.50 V

48 C

18840
3600 R

200/22440/112
200
244
200
440
400
40

138
112
260
130
130

119
112
7 Ohms inserted.

122/14568/119
122
236
122
1140
1098
42

Feb. 5, 1881.
Order 124 – R 250
105 V – 21

1.21.50 V 48 C

18840
4200 R

200/23040/115
200
304
200
1040
1000
40

130
115
650
130
130

123
115
8 Ohms inserted.

122/14950/122
122
275
244
310
244
66

Feb. 5, 1881.
Order 124 – R 255
91½ V – 19

118 112 V 48 C

18840 R
3400 R

200) 22240 (111
200
224
200
240
200
40

130
111
130

122
111
11 Ohms inserted.

130
130
118) 14430 (122
118
263
236
270
236
34

Feb. 5, 1881.
Order 124 – R 255
104 V – 14

120 15 V 48 C

18840 R
4200 R

200) 23040 (115
200
304
200
1040
1000
40

130
115
650

125
115
10 Ohms inserted.

130
130
120) 14950 (124
120
295
240
550
480
70

Feb. 5, 1881.
Order 124 - R 285
105½ V - 20

120.15 V

48 C

18840
4700 R

200 / 23540 / 117
200
354
200
1540
1400
140

130
118
1040
130

128
118
10 Ohms inserted.

130
120 / 15340 / 127
120
334
240
940
840
100

Feb. 5, 1881.
Order 48 - R 270
106 V - 4

124.83 V

18840
3000 R

200 / 21840 / 109
200
1840
1800
40

48 C

130
109
1170
130
125 / 14170 / 113
125
167
125
420
375
45

113
109
4 Ohms inserted

Feb. 5, 1881.
Order 48 - R 300
104 1/2 V - 7

Feb. 5, 1881.
Order 48 - R 285
100 1/2 V - 6

Feb. 5, 1881.
Order 48 – R 280
103 1/2 V – 7

Feb. 5, 1881.
Order 48 – R 275
99 1/2 V – 14

Feb. 5, 1881.
Order 47 - R 210
96½ V-8

114.75 Volts

18840 R 48 C
1000 R

200/19840/99
1800
1840
1800
40

130
99
1170
1170

115/12870/111
115
137
115
220
115
105

112
99
13 Ohms inserted.

Feb. 5, 1881.
Order 47 - R 225
95 V-9

116.10 Volts

18840 R
2200 R

250 | 21040
105

200/21040/105 48 C
200
1040
1000
40

130
105
650
130

116/13650/117
116
205
116
890
812
68

118
105
13 Ohms inserted.

Feb. 5, 1881.
Order 144 - R 225
106 V - 23

Feb. 5, 1881.
Order 144 - R 305
2

Feb. 5, 1881.
Order 144-R 340
116 V-15

Feb. 5, 1881.
Order 144-R
3

Feb. 5, 1881.
Order 144 - R 270
103 1/2 V - 27

Feb. 5, 1881.
Order 144 - R 240
112 1/2 V - 11

Feb. 5, 1881.
Order 144-R 260
22

Feb. 5, 1881.
Order 144-R 285
111½ V-17

Feb. 5, 1881.
Order 144 - R 330
114½ V - 6

Feb. 5, 1881.
Order 144 - R 310
6

Feb. 5, 1881.
Order 144 - R 290
111 C - 18

Feb. 5, 1881.
Order 144 - R 230
4

Feb. 5, 1881.
Order 144-R 250
28

Feb. 5, 1881.
Order 144-R 295
111/2 V-9

Feb. 5, 1881.
Order 144-R 270
99 1/2 V-26.

Feb. 5 1881.
Order 144-R 290
29

Feb. 7, 1881.
Order 129 — High
14

this one carbon is bus

Feb. 7, 1881.
Order 47 — R 235
97 V — 19

114.75 V

18840
3000 R

48 C

Feb. 7, 1881.
Order 43 - R275
118V - 17

130 V 35 C

25127
3300 R

200 | 28427
142

Feb. 7, 1881.
Order 47 - R225
99V - 12

118,12 V

1884.0
2800 R

200 | 216.40
108

48 C

Feb. 7, 1881.
Order 47 - R 225
96 V - 10

120, 15 V

18840 R
1100 R

200 | 1 99 40
48 C 99

Feb. 7, 1881.
Order 43 - R 299
High - 12

130 V at 18 C

25127 R
4900 R

200 | 300 27
150

Feb. 7, 1881.
Order 43-R. 296
110 V-4

130 V

25127 ~~00~~
3300 R
200 | 21827
109

48 C

Feb. 9, 1881.
Order 156-R. 340
No. 6

111.34 Volts. - 48 C.

12560
5200
200 | 17760 / 88
1600
1760
1600
160

90
88
2 Ohms inserted.

130
89
1170
880
111 | 9970 / 89
888
1090
999
91

Feb. 9, 1881.
Order 156-R 365
No. 9

104.62 Volts.

18840
5400
200 / 24240 / 121
200
424
400
240
200
40

121
130
3630
121
105 / 15730 / 149
105
523
420
1030
945
85

150
121
29 Ohms inserted

Feb. 9, 1881.
Order 156-R 390
No. 3

111.34 V

12560
6200
200 / 18760 / 93
1800
760
600
160

110
94
6 Ohms inserted.

130
94
520
1170
111 / 12220 / 110
111
112
111
10

Feb. 9, 1881.
Order 43 - R - 299
High - 12

130.27 V - 38 C.

18840
9700
200/28540/142
200
854
800
540
400
140

130
143
390
520
130
130/18590/143
130
559
520
390
390

Feb. 9, 1881.
Order 156 - R 375
No. 4

114.75 V

200/18700/93R
1800
700
600
100

130
94
520
1170
130/12220/94
1170
520
520

Feb. 9, 1881.
Order 156 - R 385
No. 1

114.75

18840
800

200 / 19640 / 98
1800
1640
1600
40

4 R

130
98
1040
1170

115 / 12740 / 110
115
124
115
90

111
98
3 Ohms inserted.

Feb. 9, 1881.
Order 156 - R 410
No. 8

111.34

12560
5800

200 / 18360 / 91
1800
360
200
160

4 R

130
92
260
1170

111 / 11960 / 107
111
860
777
83

108
92
16 Ohms inserted.

Feb. 9, 1881.
Order 156 - R 390
No: 3

114.75 V

12560
6000 R

18560

48 C

200/18560/92
1800
560
400
160

130
93
390
1170
115/12090/105
115
590
575
15

105
93
12 Ohms inserted

Feb. 9, 1881.
Order 156 - R 340
No: 6

109.35 V

12560
5400 R
200/17960/89
1600
1960
1800
160

48 C

130
89
1170
1040
109/11570/106
109
670
654
16

106
90
16 Ohms inserted.

Feb. 9, 1881.
Order 156 - R 365
No. 9

108. ✓

12560
6~~500~~

200 / 19060 / 95
18 00
1060
1000
60

130
96
780
1170
108 / 12480 / 115
108
168
108
600
540
60

116
96
20 Ohms inserted.

Feb. 15, 1881.
Order 145 - R 325
3

1205   C 1R

25127 R
8000

200 / 33127
165 127/200

166
130
4980
166
130 / 21580 / 166
130
858
780
780
780

Feb. 15, 1881.
Order 145 – R300
8

130 ✓

25 C

25127 R
3500

200 / 28627 / 143
200
862
800
627
600
27

130

Feb. 15, 1881.
Order 140 – R345
No. 12

130 ✓

23 C

25127 R
8000

200 / 33127 / 165
200
1312
1200
1127
1000
127

Feb. 15, 1881.
Order 140 — R 275
No. 13

130 V
busted

Feb. 15, 1881.
Order 130 — R 175
No. 75

112.72 V
48 C

18840
300

200 / 19140 / 95
18 00
1140
1000
140

130
96
780
1170
113 / 12480 / 110
113
118
113
50

111
96
15 Ohms inserted.

Feb. 15, 1881.
Order 158-R
No: 1

12015

48 e

18840 R
2100

200/20940/104
200
940
800
140

105
130
3150
105
120/13650/113
120
165
120
450
360
90

114
105
9 Ohms inserted.

Feb. 15, 1881.
Order 158-R
No: 2

121.50

48 e

18840 R
6100

200/24940/124
200
494
400
940
800
140

125
130
3750
125
122/16250/133
122
405
366
390
366
24

133
125
8 Ohms inserted.

Feb. 15, 1881.
Order 158-R
No. 3

111.34 V

48 C

1840 R
2000 R

200/20840/104
200
840
800
40

104
130
3120
104
111/13520/121
111
242
222
200
111
89

122
104
18 Ohms inserted.

Feb. 15, 1881.
Order 158-
No. 4

114.75 V

48 C

1840 R
3900 R

200/22740/113
200
274
200
740
600
140

114
130
3420
114
115/14820/128
115
332
230
1020
920
100

129
114
5 Ohms inserted.

Feb. 15, 1881.
Order 158-R
No. 5

130 V

34 C

25127 R
2900

200 / 28027 / 140
200
802
800
27

Feb. 15, 1881.
Order 158-
No. 6

12150 V

48 C

1884 0 R
2800

200 / 21640 / 108
200
1640
1600
40

108
130
3240
108

122 / 14040 / 115
122
184
122
620
610
10

115
108
7 Ohms inserted.

Feb. 15, 1881.
Order 158
No. 7

118.12 V
48 C
18840
3500 R

200 / 22340 / 111
200
234
200
340
200
140

112
130
3360
112
118 / 14560 / 123
118
276
236
400
354
46

123
112
11 Ohms inserted.

Feb. 15, 1881.
Order 138 - R 285
110 V — 28

124.83 V
48 C
18840
4100 R

200 / 22940 / 114
200
294
200
940
800
140

115
130
3450
115
125 / 14950 / 119
125
245
125
1200
1125
75

120
115
5 Ohms inserted.

Feb. 15, 1881.
Order 157—
No. 10

111.34 V

48 C

12560 ℛ
4700

200/17260/86
16 00
1260
1200
60

87
130
2610
87
111/11310/101
111
210
111
99

102
87
15 Ohms inserted.

Feb. 15, 1881.
Order 157—
No. 11

110.02 V

48 C

12560 ℛ
4300

200/16860/84
16 00
860
800
60

85
130
2550
85
110/11050/100
110
50

101
85
16 Ohms inserted.

 Feb. 15, 1881.
Order 157-R
No. 12

116.10 V
48 C

18840 R
300

200 / 19140 / 95
1800
1140
1000
140

96
130
2880
96
116 / 12480 / 107
116
880
812
68

108
96
12 Ohms inserted.

Feb. 15, 1881.
Order 157-
No. 13

113,40 V
48 C

12560 R
5100

200 / 17660 / 88
1600
1660
1600
60

89
130
2670
89
113 / 11570 / 102
113
270
226
44

102
89
13 Ohms inserted.

Feb. 15, 1881.
Order 157
No. 14

121.500

248 C

1884 0 R
1700

200/20540/102
200
540
400
140

1.03
1.30
3090

103
122/13390/109
122
1190
1098
92

110
103
7 Ohms inserted.

Feb. 15, 1881.
Order 157
No. 15

109.35

248 C

~~188.40~~

12560 R
4500

200/17060/85
1600
1060
1000
60

86
130
2580
86
109/11180/102
109
280
218
62

103
86
17 Ohms inserted.

Feb. 15, 1881.
Order 157
No. 16

111.34 V

48 C

12560 R
3200 N

200/15760/78
1400
1760
1600
160

79
130
2370
79
111/10270/92
999
280
222
58

93
79
14 Ohms inserted.

Feb. 15, 1881.
Order 157
No. 17

111.34 V

48 C

12560 R
4000

200/17360/86
1600
1360
1200
160

87
130
2610
87
111/11310/101
111
210
111
99

102
87
15 Ohms inserted.

Feb. 15, 1881.
Order 157–
No: 9

111.34 V

48 C

12560 R
5100 R

200)17660/88
1600
1660
1600
60

89
130
2670
89
111)11570/104
111
470
444
26

104
89
15 Ohms inserted.

Feb. 15, 1881.
Order 157–
No. 8

111.34 V

48 C

12560 R
3500 R

200)16060/80
1600
60

81
130
2430
81
111)10530/94
999
540
444
96

95
81
14 Ohms inserted.

Feb. 15, 1881.
Order 157 –
No. 7

111.34 V

48 C

~~25~~

1 2 5 6 0
3 7 0 0 R

200 / 1 6 2 6 0 / 81
1 6 0 0
2 6 0
2 0 0
6 0

82
130
2460
82

111 / 10660 / 96
999
670
666
4

96
82
14 Ohms inserted.

Feb. 15, 1881.
Order 157 –
No. 6

111.34 V

48 C

12560
4000 R

200 / 1 6 5 6 0 / 82
1 6 0 0
5 6 0
4 0 0
1 6 0

83
130
2490
83

111 / 10790 / 97
999
800
777
23

97
83
14 Ohms inserted.

Feb. 15, 1881.
Order 157 –
No. 5

113.40 ✓

48 ✓e

12560
5400

200/17960/89
1600
1960
1800
160

90
130
2700
90
113/11700/103
113
400
339
61

104
90
14 Ohms inserted.

Feb. 15, 1881.
Order 157 –
No. 4

114.75 ✓

48 e

12560
5100

200/17660/88
1600
1660
1600
60

81
130
2430
81
115/10530/91
1035
180
115
65

92
89
3 Ohms inserted.

Feb. 15, 1881.
Order 157 —
No. 3

114.84 V

48 C

12560
5200

200/1,776.0/88
1 6 0 0

1 7 6 0
1 6 0 0

1 6 0

89
130

2670
89

111/1157.0/104
111

470
444

26

105
89

16 Ohms inserted.

Feb. 15, 1881.
Order 157 —
No. 2

113.40 V

48 C

12560
5000

200/1756 0/87
1 6 0 0

1 5 6 0
1 4 0 0

1 6 0

88
130

2640
88

113/1144.0/101
113

140
113

27

101
88

13 Ohms inserted.

Feb. 15, 1881.
Order 157-
No. 1

11475 V
48 C

12560
6600 P

200/19160/95
1800
1160
1000
160

96
130
2880
96
115/12480/108
115
980
920
60

109
96
13 Ohms inserted.

Feb. 15, 1881.
Order 146 - R 280
No. 15

1305 V
35 C

18840
7800 P

200/26640/133
200
664
600
640
600
40

133
130
3990
133
139/17290/133
1130
429
390
390
390

Feb. 15, 1881.
Order 146 – R 280
No. 13

130 V

~~48~~ C

35 C

18840 R
8000 R

200/26840/134
200
684
600
840
800
40

134
130
4020

134
130/17420/134
130
442
390
520
520

Feb. 15, 1881.
Order 37 – R 235
No. 17

124.83 V

48 C

18840 R
2800 R

200/21640/108
200
1640
1600
40

108
130
3240

108
125/14040/112
125
154
125
290
250
40

112
108
.4 Ohms inserted.

Feb. 15, 1881.
Order 37 - R 230
No. 18

121.50 V

48 C

1884 0
900 R

200 / 19740 / 98
1800
1740
1600
140

99
130
2970
99
122 / 12870 / 105
122
670
610
60

106
99
7 Ohms inserted.

Feb. 15, 1881.
Order 192 - R 210
105½ V - 13

119.47 V

18840
2700 R

48 C

200 / 21540 / 107
200
1540
1400
140

108
130
3240
108
119 / 14040 / 117
119
214
119
950
833
117

118
108
10 Ohms inserted.

Feb. 15, 1881.
Order 192 - R 210
103½ V - 12

117.45 V

18840
300 R

48 C

200/19140/95
1800
1140
1000
140

96
130
2880
96
117/12480/106
117
780
702
78

107
96
11 Ohms inserted.

Feb. 15, 1881.
Order 192 - R 200
106 V - 19

120.15 V

18840
3100 R

48 C

200/21940/109
200
1940
1800
140

110
130
3300
110
120/14300/119
120
230
120
1100
1080
20

119
110
9 Ohms inserted.

Feb. 15, 1881.
Order 192 – R 195
104½ V – 14

119.47 V

18840
2000 R

4 re

200) 20840 (104
200
840
800
40

104
130
3120
1.04

119) 13520 (113
119
162
119
430
357
73

114
104
10 Ohms inserted.

Feb. 15, 1881.
Order 192 – R 205
100½ V – 8

118.12 V. 4 re

18840
500 R

200) 19340 (96
1800
1340
1200
1.40

97
130
2910
97

118) 12619 (106
118
810
708
102

107
97
10 Ohms inserted.

Feb. 15, 1881.
Order 192 – R 200
107½ V – 18

120.15 V 48 C

1884.0
2500

200/2134 0/106
200
1340
1200
140

107
130
3210
107
120/13910/115
120
191
120
710
600
110

116
107
9 Ohms inserted.

Feb. 15, 1881.
Order 192 – R 195
110 V – 22

121.150 V 48 C

1884 0
1600

200/284 40/102
200
440
400
40

102
130
3060
102
122/13260/108
122
1060
976
84

109
102
7 Ohms inserted.

Feb. 15, 1881.
Order 192 – R 300
109 V – 9.

118.12 V 48 C

18840 R
3000 R

200/21840/109
200
1840
1800
40

109
130
3270
109
118/14170/120
118
237
236
10

120
109
11 Ohms inserted.

Feb. 15, 1881.
Order 192 – R 345
105 1/2 V – 18

118.12 V 48 C

18840 R
2500 R

200/21340/106
200
1340
1200
140

107
130
3210
107
118/13910/117
118
211
118
930
826
104

118
107
11 Ohms inserted.

Feb. 15, 1881.
Order 192 — R 200
101 V — 4

115.43 V 48 C

18840 R
1200

200/20048/100
200
40

100
130
3000
100
115/13000/113
115
150
115
350
345
5

113
100
13 Ohms inserted.

Feb. 15, 1881.
Order 192 — R 215
105 V — 5

118.12 V 48 C

18840
2500

200/21340/106
200
1340
1200
140

107
130
3210
107
118/13910/117
118
211
118
930
826
104

118
107
11 Ohms inserted.

Feb. 15, 1881.
Order 192 – R 325
105½ V – 6

120.15 V 48 C

18840
1500

200/203 40/101
200
340
200
140

111
102
9 Ohms inserted.

102
130
3060
102
120/13260/110
120
126
120
60

Feb. 15, 1881.
Order 192 – R 200
100½ V – 1.

120.15 V 48 C

18840
4700

200/23590/117
200
359
200
1590
1400
190

128
118
10 Ohms inserted.

118
130
3540
118
120/15340/127
120
334
240
940
840
100

Feb. 15, 1881.
Order 192 - R205
99½ V - 8

114.75 V 48 e

1884 0 R
1200 R

200/2000 40/100
2000
40

100
130
3000
100
115/13000/113
115
150
115
350
345
5

113
100
13 Ohms inserted.

Feb. 15, 1881.
Order 192 - R205
103½ V - 7

116.10 V 48 e

1884 0 R
2300 R

200/21140/105
200
1140
1000
140

106
130
3180
106
116/13780/118
116
218
116
1020
928
92

119
106
13 Ohms inserted.

Feb. 15, 1881.
Order 192 - R 210
98 1/2 V - 14

118,12 V . 48 C

18840
1200 R

200/20040/100
200
40

100
130
118/13000/110
118
120
118
20

110
100
10 Ohms inserted.

Feb. 15, 1881.
Order 192 - R 236
109 1/2 V - 21

12418 3 V. 48 C

18840
4900 R

200/23740/118
200
374
200
1740
1600
140

119
130
3570
119
125/15470/123
125
297
250
470
375
95

124
119
5 Ohms inserted.

Feb: 15, 1881.
Order 192 – R 215
101 V – 5

120 : 15 V 48 C

18840 R
2500

200 / 21340 / 106
2000
1340
1200
140

107
130
3210
107
120 / 13910 / 115
120
191
120
710
600
110

116
107
9 Ohms inserted

Feb: 15, 1881.
Order 192 – R 205
100½ V – 25

116 : 10 V 48 C

18840 R
2100

200 / 20940 / 104
200
940
800
140

105
130
3150
105
116 / 13650 / 117
116
205
116
890
812
78

118
105
13 Ohms inserted.

Feb. 15, 1881.
Order 192 – R195
100 V – 27

114.75 V 48C

18840
100 R

200 / 18940 / 94
1800
940
800
140

95
130
2850
95
115 / 12350 / 107
115
850
805
45

107
96
11 Ohms inserted.

Feb. 15, 1881.
Order 192 – R355
104½ V – 29

121.50 V 48C

18840
2400 R

200 / 21240 / 106
200
1240
1200
40

106
130
3180
106
122 / 13780 / 112
122
158
122
360
244
116

113
106
7 Ohms inserted.

Feb. 15, 1881.
Order 35 - R 265
108 V - 8

~~126~~ 190 V 41 C

18840 R
7200 R

200/26040/130
200
604
600
40

130
130
3900
130
127/16900/133
127
420
381
390
381
9

133
130
3 Ohms inserted.

Feb. 15, 1881.
Order 35 - R 360
114 1/2 V - 25

130 V, 33 C

25127 R
3700 R

200/28827/144
200
882
800
827
800
27

144
130
4320
144
130/18720/144
130
572
520
520
520

Feb. 15, 1881.
Order 35 - R 325
106 1/2 V - 1

124,83 V 48e

18840 V R
3900

200 / 22740 / 113
200
274
200
740
600
140

114
130
3420
114

125 / 14820 / 118
125
232
125
1070
1000
70

119
114
5 Ohms inserted.

Feb. 15, 1881.
Order 35 - R 235
108 1/2 V - 24

124,23 V 48e

18840
4800 R

200 / 23640 / 118
200
364
200
1640
1600
40

118
130
3540
118

124 / 15340 / 123
124
294
248
460
372
88

124
118
6 Ohms inserted.

Feb. 15, 1881.
Order 35-R 315
102 V-23

113405 48e

18840
4500

200/23340/116
200
334
200
1340
1200
140

135
117
18 Ohms inserted.

117
130
3510
117
113/15210/134
113
391
339
520
452
68

Feb. 15, 1881.
Order 35-R 210
108 1/2 V-12

121505 48e

18840
5500

200/24340/121
200
434
400
340
200
140

130
122
8 Ohms inserted.

122
130
3660
122
122/15860/130
122
366
366
0

Feb. 15, 1881.
Order 35-R 190
104 V - 18

122.85 V 48 C

1840 Ω
5000 Ω

200 / 23840 / 119
200
384
200
1840
1800
40

119
130
3570
119
123 / 15470 / 125
123
317
246
710
615
95

126
119
7 Ohms inserted.

Feb. 15, 1881.
Order 35-R 335
High - 20

120 V. 26 C

1840 Ω
7000 Ω

200 / 25840 / 129
200
584
400
1840
1800
40

129
130
3870
129
130 / 16770 / 129
130
377
260
1170
1170

Feb. 15, 1881.
Order 35-R 315
105 V - 30

122.85 V 48

18840 R
3200 R

200)22040(110
200
204
200
40

110
130
3300
110
123)14300(116
123
200
123
770
738
32

116
110
6 Ohms inserted.

Feb. 15, 1881.
Order 35-R 350
106 1/2 V - 20

126.905 48 C

18840 R
5200 R

200)24040(120
200
404
400
40

120
130
3600
120
127)15600(122
127
290
254
360
254
106

123
120
3 Ohms inserted.

Feb. 18, 1881.
Order 205-
94 V-1 +

101.25 V Bulneal Dep.
C48

12560
5800
200 / 18360 / 91
18000
360
200
160

92
130
2760
92
101 / 11960 / 118
101
186
101
850
808
42

118
92
26 Ohms inserted.

Feb. 18, 1881.
Order 205- +
104 1/2 V-21

120.82 V

18840
3300
200 / 22140 / 110
200
214
200
140

111
130
3330
111
121 / 14430 / 119
121
233
121
1120
1089
31

119
111
8 Ohms inserted.

Feb. 18, 1881.
Order 150 – R 520
102 V – 4

114.75 V 48 C

18843 R
3500

200) 22340 (111
200
234
200
340
200
140

112
130
3360
112
115) 14560 (126
115
306
230
760
690
70

127
112
15 Ohms inserted.

Feb. 18, 1881.
Order 150 – R 480
104 1/2 V – 10

118.12 V 48 C

18849 R
2100

200) 20940 (104
200
940
800
140

105
130
3150
105
118) 13650 (115
118
185
118
670
590
80

116
105
11 Ohms inserted.

Feb. 18, 1881.
Order 150 – R500
111 V – 27

118.125 V 48

18840
2500

200/21340/106
200
1340
1200
140

107
130
3210
1.07
118/13910/117
118
211
118
930
826
104

118
107
11 Ohms inserted.

Feb. 18, 1881.
Order 205 –
94 V – 19 B +

104.62 V 48

12560
7400

200/19960/99
1800
1960
1800
160

100
130
105/13000/123
105
250
210
400
315
85

124
100
24 Ohms inserted.

Feb. 18, 1881.
Order 205 - 91½ V
7 +

106.65 V 48 ℓ

12560
7100 ℓ

200/19660/98
1800
1660
1600
60

99
130
2970
99
107/12870/120
107
217
214
30

120
99
21 Ohms inserted.

Feb. 18, 1881.
Order 205 +
95 V - 3

~~12560~~

106.65 V 48

12560
5400 ℓ

200/17960/89
1600
1960
1800
160

90
130
2700
90
107/11700/109
107
1000
963
37

109
90
19 Ohms inserted.

Feb. 18, 1881.
Order 205
97½ V - 12[A]

105.88 V 48 Ω

12560
6300 R

200) 18860 / 94
1800
860
800
60

95
130
2850
95
106) 12350 / 116
106
175
106
690
636
54

117
95
22 Ohms inserted.

Feb. 18, 1881.
Order 205 -
95 V - 19[A+]

104.62 V 48 Ω

12560
6400 R

200) 18960 / 94
1800
960
800
160

95
130
2850
95
105) 12350 / 117
105
185
105
800
735
65

118
95
23 Ohms inserted.

Feb. 18, 1881.
Order 205 - +
96 V - 25

102.6 V 48 C

12560 Ω
6200 Ω

200/18760/93
1800
760
600
160

94
130
2820
94
103/12220/118
103
192
103
890
824
66

119
94
25 Ohms inserted.

Feb. 18, 1881.
Order 205 - +
96 V - 13

103.2 V 48 C

12560 Ω
5500 Ω

200/18060/90
1800
60

91
130
2730
91
103/11830/114
103
153
103
500
412
88

115
91
24 Ohms inserted.

Feb. 18, 1881.
Order 205 -
98 V - 11

109.880 ...

12560
6700 R

200 / 19260 / 96
1800
1260
1200
60

97
130
2910
97
109 / 12610 / 115
109
171
109
620
545
75

116
97
19 Ohms inserted.

Feb. 18, 1881.
Order 205 - +
97½ V - 5

109.355 ✓

12560
6000 R

200 / 18560 / 92
1800
560
400
160

93
130
2790
93
109 / 12090 / 110
109
119
109
100

111
93
18 Ohms inserted.

Feb. 18, 1881.
Order 205 - +
98½ V-17

1.09.355 48 e

~~10.~~ 12560 R
9100

200/21660/108
200
1660
1600
60

109
130
3270
109
109/14170/130
109
327
327
0

.130
109
21 Ohms inserted.

Feb. 18, 1881.
Order 202
107½ V-1

112.72 V 48 e

12560
9300 R

200/21860/109
200
1860
1800
60

110
130
3300
110
113/14300/126
113
300
226
740
678
62

127
110
17 Ohms inserted.

Feb. 18, 1881.
Order 202
110 V – 13

118.12 V 48 C

18840 R
5900 R

200/24740/123
200
474
400
740
600
140
124
130
3720
124
118/16120/136
118
432
354
780
708
72

137
124
13 Ohms inserted.

Feb. 18, 1881.
Order 202
105 1/2 V – 12 B

118.12 V 48 C

18840 R
3400 R

200/22240/111
200
224
200
240
200
40

111
130
3330
111
118/14430/122
118
263
236
270
236
34

122
111
11 Ohms inserted.

Feb. 18, 1881.
Order 202 - 114½ V
12 A

126.90 V 48 C

1840 R
4800
200/23640/118
200
364
200
1640
1600
40

118
130
3540
118
127/15340/120
127
264
254
100

128
118
10 Ohms inserted.

Feb. 18, 1881.
Order 202 - 115 V
20 (B)

124.83 V 48 C

1840 R
3300
200/22140/110
200
214
200
140

111
130
3330
111
125/14430/115
125
193
125
680
625
55

116
111
5 Ohms inserted.

Feb. 18, 1881.
Order 202 - 107½ V
20 (A)

118.12 V 48 C

18840 R
2900
200 / 21740 / 108
200
1740
1600
140

109
130
3270
109
118 / 14170 / 120
118
237
236
10

120
109
11 Ohms inserted.

Feb. 18, 1881.
Order 202 - 105½ V
30.

118.12 V 48 C

18840 R
2500
200 / 21340 / 106
200
1340
1200
140

106
130
3180
106
118 / 13780 / 116
118
198
118
800
708
92

117
107
10 Ohms inserted.

Feb. 18, 1881.
Order 202-106 1/2 V
3

120.115 V 48 C

14840 R
2300

200/21140/105
200
1140
1000
140

106
130
3180
106
120/13780/114
120
178
120
580
480
100

115
106
9 Ohms inserted.

Feb. 18, 1881.
Order 202-111 1/2 V
11

126.22 V 48 C

18840 R
3300

200/22140/110
200
214
200
140

111
130
3330
111
126/14430/114
126
183
126
570
504
66

115
111
4 Ohms inserted.

Feb. 18, 1881.
Order 202-108V
18 (B)

121.50 V 48 C

18840 R
1300

200/20140/100
200
140

101
130
3030
101

122/13130/107
122
930
854
76

108
101
7 Ohms inserted.

Feb. 18, 1881.
Order 202-109V
18 (A)

118.12 V 48 C

18840 R
1400

200/20240
101 40/200

101
130
3030
101

118/13130/111
118
133
118
150
118
32

111
101
10 Ohms inserted.

Feb. 18, 1881.
Order 202-109 V
2 (B)

124.8315 48 e

18840 R
5 200

$$200 \overline{)\,24040}$$
$$120\frac{40}{200}$$

120
130
3600
120

$$125 \overline{)\,15600}\;/124$$
125
310
250
600
500
100

125
120
5 Ohms inserted.

Feb. 18, 1881.
Order 202-109 V
2 (A)

121.500 48 e

18840 R
3200

$$200 \overline{)\,22040}\;/110$$
200
204
200
40

110
130
3300
110

$$122 \overline{)\,14300}\;/117$$
122
210
122
880
854
26

117
110
7 Ohms inserted.

Feb. 18, 1881.
Order 202 - 111 V
7 (A)

124.83 V 48 C

18840 R
3400 R

$200 \overline{)22240}$
$111 \frac{40}{200}$

111
130
3330
111

$125 \overline{)14430} / 115$
125
193
125
680
625
55

116
111
5 Ohms inserted.

Feb. 18, 1881.
Order 202 - 106 V
7 (B)

111.34 V 48 C

18840 R
1600 R

$200 \overline{)20440}$
$102 \frac{40}{200}$

102
130
3060
102

$111 \overline{)13260} / 119$
111
216
111
1050
999
51

120
102
18 Ohms inserted.

Feb. 18, 1881.
Order 202-106 1/2 V
17

111.345 48 C

18840 R
400

200/22840
114 40/200

114
130
3420
114

111/14820/133
111
372
333
390
333
57

134
111
23 Ohms inserted.

Feb. 18, 1881.
Order 202-104 1/2 V
5

118.125 48 C

18840 R
3000

200/21840
109 40/200

118:120::109:-

109
130
3270
109

118/14170/120
118
237
236
10

120
109
11 Ohms inserted.

Feb. 18, 1881.
Order 202–102½ V
24 (B)

114.07 V 48 C

18840 R
9000
200/19740
98 140/200

99
130
2970
99
114/12870/112
114
147
114
330
228
102

113
99
14 Ohms inserted.

Feb. 18, 1881.
Order 202–107½ V
24 A

120.15 V 48 C

18840 R
2200
200/21040
105 40/200

105
130
3150
105
120/13650/113
120
165
120
450
360
90

114
105
9 Ohms inserted.

Feb. 18, 1881.
Order 202 – 118½ V
6 D

124.83 V 48 C

18840
4200

200/23040
11 5 40/200

115
130
3450
115
125/1.4950/119
125
245
125
1200
1125
75

120
115
5 Ohms inserted.

Feb. 18, 1881.
Order 202 – 107 V
6 (C)

119.47 V 48 C

18840
3000

200/21840
109 40/200

109
130
3270
109
119/14170/119
119
227
119
1080
1071
9

119
109
10 Ohms inserted.

Feb. 18, 1881.
Order 202-102V
6(B)

118.12V 48C

18840 R
4200

200/23040
115 40/200

115
130
3450
115
118/14950/126
118
315
236
790
708
82

127
115
12 Ohms inserted.

Feb. 18, 1881.
Order 202-110V
6(A)

121.50V 48C

18840 R
3700

200/22540
112 140/200

113
130
3390
113
122/14690/120
122
249
244
50

121
112
9 Ohms inserted.

Feb. 18, 1881.
Order 202 – 110 V
29

121.50 V 48 C
18840 R
2200 R

$$200 \overline{)21040}$$
$$105\tfrac{40}{200}$$

$$\begin{array}{r} 105 \\ \times 130 \\ \hline 3150 \\ 105 \\ \hline \end{array}$$

$$\begin{array}{r} 122 \overline{)13650}/111 \\ 122 \\ \hline 145 \\ 122 \\ \hline 230 \\ 122 \\ \hline 108 \end{array}$$

$$\begin{array}{r} 112 \\ 105 \\ \hline 7 \end{array}$$ Ohms inserted.

Feb. 18, 1881.
Order 202 – 111 V
30

121.50 V 48 C
18844 R
2700 R

$$200 \overline{)21544}$$
$$102\tfrac{144}{200}$$

$$\begin{array}{r} 102 \\ 130 \\ \hline 3060 \\ 102 \\ \hline \end{array}$$

$$\begin{array}{r} 122 \overline{)13260}/108 \\ 122 \\ \hline 1060 \\ 976 \\ \hline 84 \end{array}$$

$$\begin{array}{r} 109 \\ 103 \\ \hline 6 \end{array}$$ Ohms inserted.

Feb. 18, 1881.
Order 202-120 V
27

130 V 48 C

18840
5000

200 / 23840
119 $\frac{40}{200}$

119
130
3570
119
130 / 15470 / 119
130
247
130
1170
1170

Feb. 18, 1881.
Order 202 - High.
22A

no vac. [illegible] up

Feb. 18, 1881.
Order 202 - 106 V
9 (B)

116,105 48 C

$$\begin{array}{r} 18840 \\ 700 \\ \hline 200 \,/\, 19540 \\ 97\tfrac{140}{200} \end{array}$$

R

$$\begin{array}{r} 98 \\ 130 \\ \hline 2940 \\ 98 \\ \hline 116 \,/\, 12740 \,/\, 109 \\ 116 \\ \hline 1140 \\ 1044 \\ \hline 96 \end{array}$$

$$\begin{array}{r} 110 \\ 98 \\ \hline 12 \end{array}$$ Ohms inserted.

Feb. 18, 1881.
Order 202 - 107½ V
9 (A)

120.15 V 48 C

$$\begin{array}{r} 18840 \\ 1800 \\ \hline 200 \,/\, 20640 \\ 103\tfrac{40}{200} \end{array}$$

R

$$\begin{array}{r} 103 \\ 130 \\ \hline 3090 \\ 103 \\ \hline 120 \,/\, 13390 \,/\, 111 \\ 120 \\ \hline 139 \\ 120 \\ \hline 190 \\ 120 \\ \hline 70 \end{array}$$

$$\begin{array}{r} 112 \\ 103 \\ \hline 9 \end{array}$$ Ohms inserted.

Feb. 18, 1881.
Order 202 – 111 V
14 B

126.90 V 48 C

18840
3200
200 | 22040
110 R
130
3300
110
127 | 14300 / 112
127
160
127
330
254
76

113
110
3 Ohms inserted

Feb. 18, 1881.
Order 202 – 106½ V
14 A.

121.50 V 48 C

18840
1200 R
200 / 20040
100 40/200

100
130
3000
100
122 / 13000 / 106
122
800
732
68

107
100
7 Ohms inserted.

Feb. 18, 1881.
Order 202 – 107½ V
23 B

120.82 V 48 C

$$\begin{array}{r} 18840 \\ 2800 \\ \hline 200\,)\,21640 \\ \hline 108\tfrac{40}{200} \end{array}$$

$$\begin{array}{r} 108 \\ 130 \\ \hline 3240 \\ 108 \\ \hline 121\,)\,14040\,(116 \\ 121 \\ \hline 194 \\ 121 \\ \hline 730 \\ 726 \\ \hline 4 \end{array}$$

$$\begin{array}{r} 116 \\ 108 \\ \hline 8 \end{array}$$ Ohms inserted.

Feb. 18, 1881.
Order 202 – 114½ V
23 A

127.57 V 148 C

$$\begin{array}{r} 18840 \\ 4300 \\ \hline 200\,)\,23140 \\ \hline 115\tfrac{140}{200} \end{array}$$

$$\begin{array}{r} 116 \\ 130 \\ \hline 3480 \\ 116 \\ \hline 128\,)\,15080\,(117 \\ 128 \\ \hline 228 \\ 128 \\ \hline 1000 \\ 896 \\ \hline 104 \end{array}$$

$$\begin{array}{r} 118 \\ 116 \\ \hline 2 \end{array}$$ Ohms inserted.

Feb. 18, 1881.
Order 202-110 V
26

121.50V 48C
18840
2600 R

200/21440
107 $\frac{40}{200}$

107
130
3210
107
122/13910/114
122
171
122
490
488
2

114
107
7 Ohms inserted.

Feb. 18, 1881.
Order 202-114 V
10 B

124.20V 48C
18840 R
4900
200/23740
118 $\frac{140}{200}$

119
130
3570
119
124/15470/124
124
307
248
590
496
94

125
119
6 Ohms inserted.

Feb. 18, 1881.
Order 202-107V
10A

118.80V 48C

200 / 18840 R.
94 40/200

94
130
2820
94

119 / 12220 / 102
119
320
238
82

103
94
9 Ohms inserted.

Feb. 18, 1881.
Order 202-107V
15(B)

119.47V 48C

18840 R
1200 R
200 / 20040
100 40/200

100
130

119 / 13000 / 109
119
1100
1071
29

109
100
9 Ohms inserted.

Feb. 18, 1881.
Order 202-92V
15A

104.62V, 48C

12560
6000

200/18560
92 160/200

93
130
2790
93
105/12090/115
105
159
105
540
525
15

115
93
22 Ohms inserted.

Feb. 18, 1881.
Order 202-103V
4B

114.75V 48C

12560
5300

200/17860
89 60/200

90
130
115/11700/101
115
200
115
85

102
90
12 Ohms inserted.

Feb. 18, 1881.
Order 202 - 99½ V
4A

114.07 V 48 C

~~1...~~

12560
8100 R

200 / 20660
103 60/200

104
130
3120
104
114 / 13520 / 118.
114
210
114
960
912
48

118
104
14 Ohms inserted.

Feb. 18, 1881.
Order 202 - 103 V
28

112.05 V 48 C

12560
8400 R

200 / 20960
104 160/200

105
130
3150
105
112 / 13650 / 121
112
245
224
210
112
98

122
105
17 Ohms inserted.

Feb. 18, 1881.
Order 202-106 V
25

113.40 V 48 C

9000 V
1256 V R

200 / 21560
107 160/200

108
130
3240
108

113 / 14040 / 124
113
274
226
480
452
28

124
108
16 Ohms inserted.

Feb. 18, 1881.
Order 202-107½ V
22

113.40 V 48 C

9000 V
1256 V R

200 / 21560
107 160/200

108
130
3240
108

113 / 14040 / 124
113
274
226
480
452
28

124
108
16 Ohms inserted.

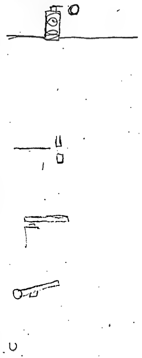
Feb. 18, 1881.
Order 202 - 107 V
16 (B)

11475 V. @48

12560
8000 R

200/20560
10 2 160
200

103
130
3890
103
115/13390/116 117
115 103
189 14 Ohms inserted.
115
740
690
50



PUBLICATION AND MICROFILM COPYING RESTRICTIONS

A Note on the Sources

40

END

FINANCIAL CONTRIBUTORS

PRIVATE FOUNDATIONS

Alfred P. Sloan Foundation
Charles Edison Fund
The Hyde and Watson Foundation
Geraldine R. Dodge Foundation

PUBLIC FOUNDATIONS

National Science Foundation
National Endowment for the Humanities

PRIVATE CORPORATIONS AND INDIVIDUALS

Alabama Power Company
Amerada Hess Corporation
AT&T
Atlantic Electric
Association of Edison Illuminating Companies
Battelle Memorial Institute Foundation
The Boston Edison Foundation
Cabot Corporation Foundation
Carolina Power and Light Company
Consolidated Edison Company of New York, Inc.
Consumers Power Company
Corning Glass Works Foundation
Duke Power Company
Exxon Corporation
Florida Power & Light Company
General Electric Foundation
Gould Inc. Foundation
Gulf States Utilities Company
Idaho Power Company
International Brotherhood of Electrical Workers
Iowa Power and Light Company
Mr. and Mrs. Stanley H. Katz
Matsushita Electric Industrial Co., Ltd.
McGraw-Edison Company
Middle South Services, Inc.
Minnesota Power
New Jersey Bell Telephone Company
New York State Electric & Gas Corporation
North American Philips Corporation
Philadelphia Electric Company
Philips International B.V.
Public Service Electric and Gas Company
RCA Corporation
Robert Bosch GmbH
San Diego Gas & Electric
Savannah Electric and Power Company
Schering Plough Foundation
Texas Utilities Company
Thomson-Brandt
Transamerica Delaval Inc.
Westinghouse Educational Foundation
Wisconsin Public Service Corporation

Thomas A. Edison Papers
at
Rutgers, The State University
endorsed by
National Historical Publications and Records Commission
18 June 1981

The original documents in this edition are from the archive at the Edison National Historic Site at West Orange, New Jersey.

Thomas A. Edison Papers

A SELECTIVE MICROFILM EDITION

PART II
(1879–1886)

Thomas E. Jeffrey
Microfilm Editor and Associate Director

Paul B. Israel
Assistant Editor

Mary Ann Hellrigel
David W. Hutchings
Douglas G. Tarr
Robert A. Rosenberg
Editorial Associates

Leonard DeGraaf
Joseph P. Sullivan
Alan Stein
Karen Kozak
John Deasey
Barbara B. Tomblin
Jacquelyn Miller
Maria Antonakakis
Student Assistants

Keith A. Nier
Assistant Editor

Reese V. Jenkins
Director and Editor

Sponsors
Rutgers, The State University of New Jersey
National Park Service, Edison National Historic Site
New Jersey Historical Commission
Smithsonian Institution

University Publications of America
Frederick, Maryland
1987

Association for Information and Image Management

MS303-1980

Centimeter

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 mm

1 2 3 4 5

Inches